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THE MALAYAN AGRICULTURAL JOURNAL

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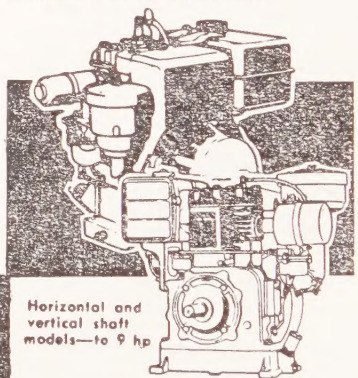

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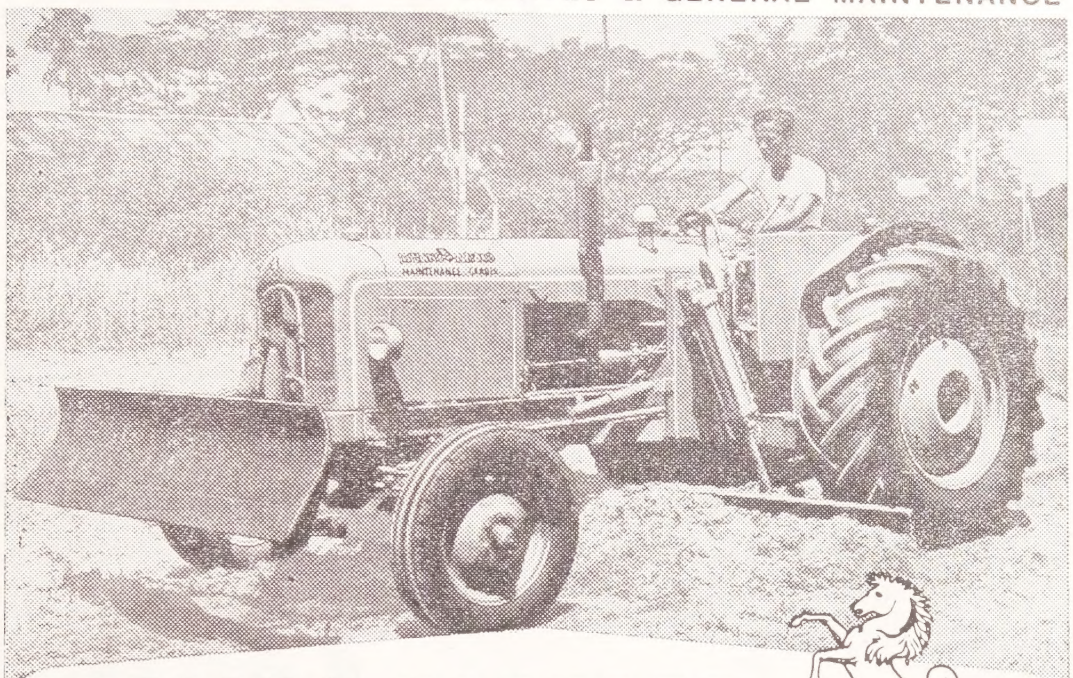

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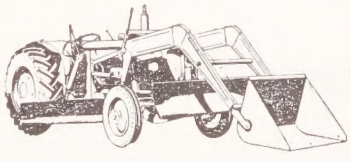

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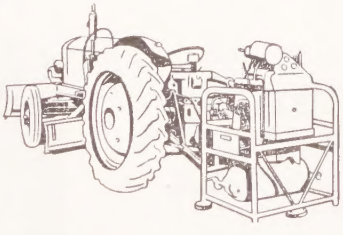

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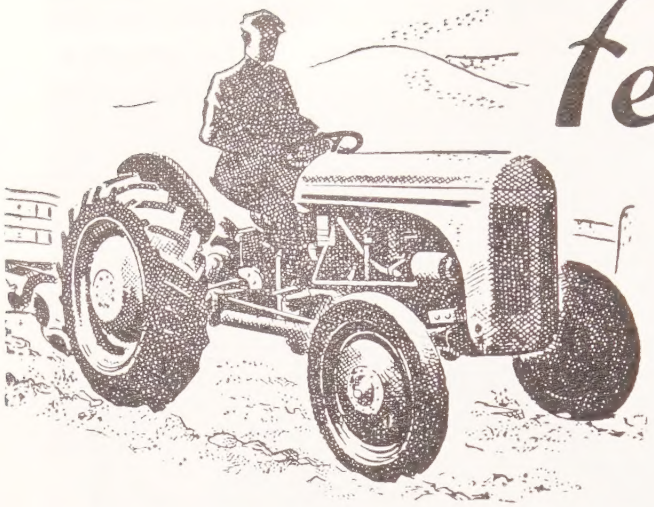

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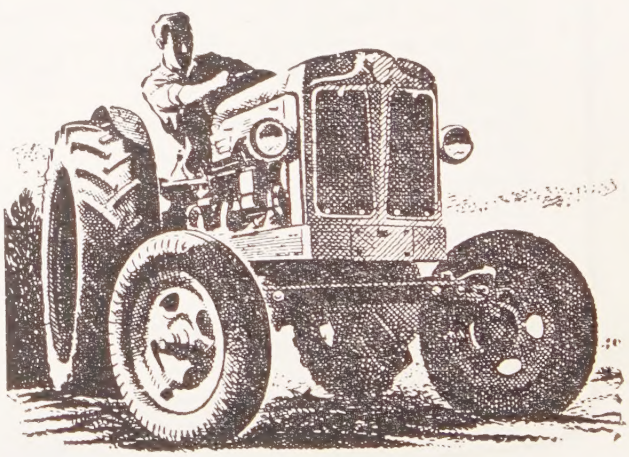

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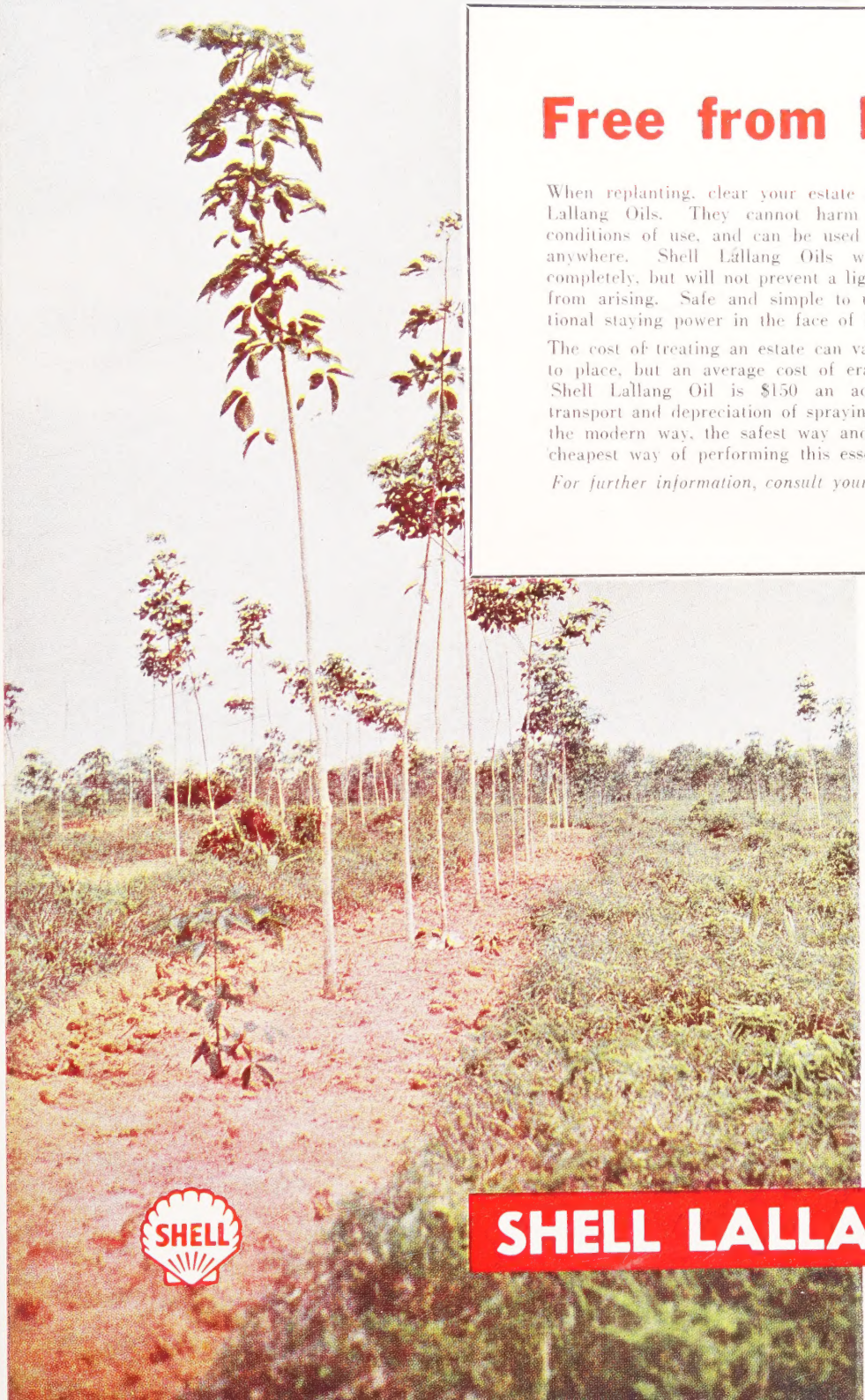

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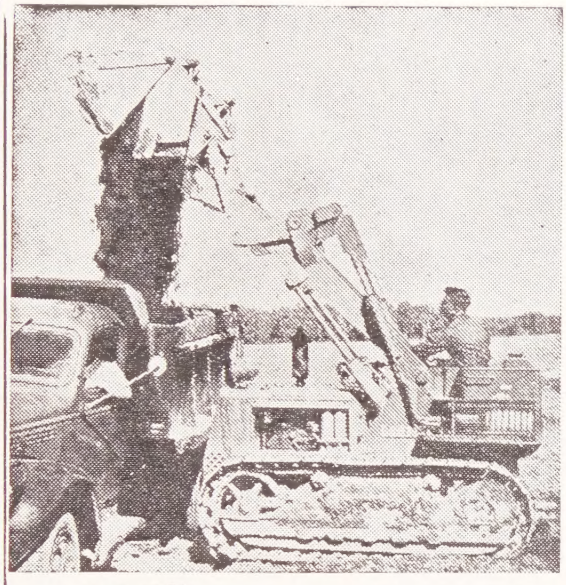

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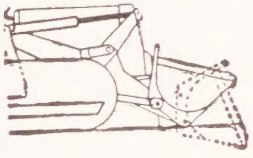

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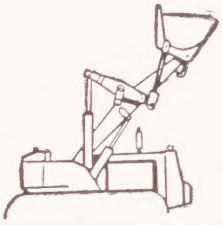

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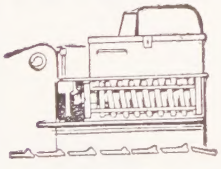

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THE MALAYAN AGRICULTURAL JOURNAL

The Journal which is published quarterly, is designed to present — as far as possible in non-technical terms — the results of the agricultural research, investigation and extension work performed by the Department of Agriculture and it draws attention to the results of work of a similar nature in other countries.

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The Journal and other publications may be obtained from the Department of Agriculture, Kuala Lumpur, Federation of Malaya, or from the office of the Commissioner for Malaya in the United Kingdom, 57, Trafalgar Square, London, W.C.2.

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THE

Malayan Agricultural Journal

Vol. 41, No. 3, 1958.

EDITORIAL

Mineral Nutrition of the Oil Palm in Malaya. This article by Mr. Coulter gives an interesting description of the use of frond analyses as a guide to the manurial requirements of the oil palm and concludes with a tentative statement regarding the optimum levels of the major and minor nutrient elements for old and young palms on different types of soil.

Fungicidal Seed Dressing of Soya Bean, Groundnut and Long Bean. A note by Mr. Johnston on his investigations into the effect of applying different fungicidal seed dressings to soya bean, groundnut and long bean indicates that a positive improvement in germination of soya been seeds can be achieved by the use of this technique.

Dry-Season Cultivation of Crops on Islands and River banks in Kelantan. Haji Mahmood bin Haji Yaacob has contributed a useful account of the way in which Kelantan farmers make use in the dry-season of land which is subjected to flooding during the monsoon. Of particular interest is his description of the system of land "auctions" by which the right to cultivate such land is obtained.

The next issue of the Malayan Agricultural Journal, Volume 41, Number 4, will be a special edition devoted entirely to different aspects of padi production in Malaya. This will place on record Malaya's leading position in tropical rice research and describe how the high yields per acre have been achieved.

It will be nearly double the size of the present issue and will contain reviews of progress in rice cultivation techniques and research, together with an account of different methods of obtaining improved yields, from nursery management throughout the cycle of transplanting and harvesting. The most recent information on rice variety trials will be summarised and there will also be a review of fertilizer investigations since 1955.

Special articles will include "Effect of Seedling Age on Transplanted Rice" by F.B. Brown, "Fungicidal Treatment of Padi Seed" by A. Johnston, "Effect of Depth and Movement of Water on the Growth

and Yield of Rice Plants" by Dr. R.G. Lockard, and "Some Aspects of Rice Milling" by T.B. Wilson.

It is anticipated that this special issue of the Malayan Agricultural Journal will be in considerable demand and orders should be placed without delay.

MINERAL NUTRITION OF THE OIL PALM IN MALAYA
The Use of Frond Analyses as a Guide to Manurial Requirements

BY

J. K. COULTER,

Acting Assistant Director (Research).

Introduction

There are approximately 110,000 acres of oil palm in Malaya, all grown on an estate basis. These estates are sited on a variety of soils and the variations in yield makes it obvious that the oil palm is sensitive to soil fertility in spite of its survival under relatively adverse conditions.

One of the most striking features of oil palm cultivation in Malaya is the very much greater yields in this country as compared to Africa. Table I shows yields which have been recorded by four well-managed estates on varying soil types with different ages of palms and from two botanical trials (those marked with an asterisk).

Table I

Yield Per Acre on Different Soil Types

Age of palms (Years)	Soil Type	Bunch Weight (lb. per annum: 5 year average)
6	Marine alluvium	22,180 *
28	,, ,,	17,510
27	Peat (3 ft deep)	13,030
6	Upland soil	9,180 *
17	,, ,,	14,140
20	,, ,,	9,300

* Yielding in 6th year of planting.

Yields in Africa are, on the other hand, considerably lower. Haines and Benzian (14) in experiments carried out in West Africa give the highest yield as 8,600 lb. of bunches per acre, which, using a conversion factor of 16 per cent oil to bunch weight gives a yield of oil of 1,380 lb. per acre. Broeshart (3) quotes a figure of 9.6 tons per hectare (8,700 lb. per acre) of bunches for blocks where potassium, phosphorus and magnesium were considered optimum. Ferrand and Ollagnier (12) give the highest yield in a manurial trial as 46.2 kilos per palm (equivalent to 5,690 lb. of bunches per acre).

It is probable that the better rainfall distribution in Malaya combined with better soils, especially the coastal clays, are the factors largely responsible for the higher yields.

The soils on which oil palms are grown in Malaya can be divided into three major groups. These are alluvial, peats or peaty soils and

mineral upland, the term 'upland' being used to denote a soil formed *in situ*, and does not refer to its elevation. Alluvial soils, the greater proportion of which are marine deposits, may vary from loamy sands to heavy clays, but the soils on the west coast, where the oil palms are grown, are mostly heavy clays. Peat may vary in depth from a few inches to many feet but very few palms are planted on peat deeper than 3 ft; on peat more than this depth, growth is generally very poor. Many of the shallow organic soils classified by planters as peat, are actually muck-soils or organic clays, as their ash content is too high for them to be classified as peats.

The nature of the parent rock determines, to a large extent, the type of upland soil. The finer-grained igneous rocks give the best soils but the majority of upland soils on which oil palms are grown are derived from sedimentary rocks consisting mostly of shales and sandstones. Laterite is often strongly developed in soils derived from shales and where there is a layer of laterite near the surface, growth of the palms is inevitably poor.

The Application of Foliar Analysis

The theoretical basis for foliar analysis has been thoroughly discussed by Lundegardh (15), Goodal and Gregory (13), Thomas (20), Ulrich (21) and many others. Its application to the oil palm has been largely due to Broeshart in the Belgian Congo, Prevot, Ollagnier and Scheidecker in French West Africa and Chapman and Gray in Malaya. These workers have attempted to correlate the levels of the major nutrients in various parts of the fronds with the need for fertilisers and the response obtained on application of these fertilisers.

It should be noted, however, that there are many difficulties in the interpretation of results from foliar analysis. Analyses show which element or elements are deficient, not how the plant became deficient or how to overcome that deficiency. For example, a low potash supply may lead to increased calcium and magnesium levels in the plant (21). Similarly, in plants deficient in nitrogen, potassium may accumulate in the plant, but once a liberal nitrogen supply is given the plants may become deficient in potash. In sand culture experiments it has been found that for some plants, a deficiency of calcium may bring about iron deficiency symptoms (16). It has also been noted that where the growth of old palms is poor and they are obviously suffering from malnutrition, the levels of P,K,Ca and Mg are fairly near normal while nitrogen is very low. It is thus possible that low nitrogen in old palms is an indication of generally poor nutrition. Nevertheless, foliar analysis has several advantages and these have been summarised by Broeshart (2) who shows that with the present lack of fundamental knowledge of tropical soils, soil analysis is unsatisfactory as a basis for advisory work on manuring.

In the practical application of the results of foliar analysis the usual method is to set a "critical concentration" below which the nutrient

is regarded as deficient. Ulrich (21) states that the critical concentration may be defined either in terms of the nutrient concentration that is just deficient for maximum growth or that which is just adequate for maximum growth. For the oil palm, Broeshart, Prevot and Ollagnier, and Chapman and Gray have given values for critical concentrations. In later work Broeshart (6) suggests that advice based on "critical levels" may not always be satisfactory. He contends that all deviations from the "normal concentration" should be considered together when deciding which deficiencies exist. He suggests that palms with an adequate supply of plant nutrients, whether growing in a light sandy soil, a heavy clay or a nutrient solution have this normal concentration.

There is thus a considerable amount of information on the use of oil palm leaf analysis for advisory work but this is largely for other, very different areas where, as pointed out, yields are generally much lower than in Malaya. Some of the work carried out in Malaya by Chapman and Gray (10) and Coulter and Rosenquist (11) can be used as a basis for advisory work but the scope of these investigations was limited. That of Chapman and Gray was concerned with one estate which did not include the important coastal alluvial group of soils and the peat was not typical of the large peat areas on the coastal belt. Similarly, the work of Coulter and Rosenquist was confined to a small area of palms grown on one soil type.

Scope of the Present Investigation

It is probable that age and position of the *pinnae* on the frond, age and variety of the palms, stage in the fruiting cycle and soil type, all influence the nutrient status of the fronds. The present investigation was designed to examine these factors and thus cover a wider range of conditions than had been done hitherto in Malaya. Having obtained this information the next step was to study the variation of levels in high yielding areas and from these to suggest optimum levels which would be of use in advisory work. These optimum levels are also discussed in the light of results from Africa.

While the ideal lay-out for this type of investigation is a comprehensive series of manurial experiments on palms of different ages on all the major soil types, for studying the inter-relationships of leaf analyses, manurial treatment and yield, such a lay-out was not available. Some experiments on coastal clay were available but the major part of the investigation was on non-experimental areas of estates. Estates in Malaya keep accurate records of yields, manuring, planting dates, etc., so that much useful information exists in their records. By taking samples from different ages of palms on different soils and with different yields it was possible to study the influence of these factors on the nutrient levels in the palms.

Sampling and Analytical Methods

Fronds from ten palms constituted one composite sample; two central pairs of *pinnae* were taken from each frond. When an estate

was sampled, the fields were divided into approximately 10-acre blocks and one composite sample was taken from one block. This gave a sampling rate of approximately one palm in fifty. The samples were brought back to the laboratory within six hours of being taken and were stored in a "deep freeze" cabinet. The sub-sample consisted of four inches in the middle of the *pinnae*; from this the mid-rib was removed and the material chopped into half-inch lengths. This was dried for 24 hours at 70° C in a specially constructed oven (17) and was then stored in a polythene bag.

Nitrogen was estimated by the micro-Kjeldahl method on a sample which had been finely ground in a coffee grinder and then re-dried in the oven. Initially, analyses were carried out in duplicate, but duplicates varied by less than one per cent and in subsequent analyses duplicates were only carried out on one sample in ten.

Phosphorus, potassium, calcium, magnesium, iron and manganese were determined in the dry ash. The merits of wet versus dry ashing are subject to various discussions and some investigators state that bases are absorbed on the silica on dry ashing and are not completely removed by the acid extraction. On the other hand, while wet ashing was found to be suitable for determination of iron and manganese, it was less convenient for the major elements, particularly phosphorus.

In the dry ashing method, ashing is the most critical part of the analysis and was carried out by heating in a muffle furnace for three hours at 300° C and 12 hours at 550° C. When ashing was carried out properly, a white ash resulted. Such an ash was easy to obtain in young fronds but more difficult in older fronds. The ash was heated in an oven for three hours at 110° C, was weighed and extracted with sulphuric and hydrochloric acids. Phosphorus was determined by the molybdenum blue method; potassium in a Lange flame photometer; calcium and magnesium by the "Versenate" titration method, after passing the solution through an ion exchange column to remove the phosphorus; manganese was estimated colourimetrically using periodate and iron by thiocyanate.

An investigation of the error between duplicates in determinations of the various nutrients was carried out and the results are shown in Table II:

Table II

Analytical Error between Duplicates

Determination		S.E. of one analysis
per cent D.M.		
Ash	....	± 0.117
Phosphorus	....	± 0.0037
Potassium	....	± 0.043
Calcium	....	± 0.0076
Magnesium	....	± 0.0062
p.p.m.D.M.		
Manganese	....	± 5.81
Iron	....	± 3.49

In every case the error is very small.

Expression of Results

This is a matter on which there would appear to be little agreement between various workers. Chapman and Gray express their results as percentage oxide in ash, Broeshart (2) as percentage element in ash, Prevot and Ollagnier as percentage element in dry matter. There is little justification for the outmoded method of expression as oxide and the question is whether the results should be expressed as percentage ash or percentage dry matter. Broeshart (2) states that expression on ash basis has definite advantages since there can be variations in the percentage of ash to dry matter. However, if the ashing is carefully carried out, this should not arise. Goodal and Gregory (13) state that the method of expression should be selected which gives the best correlation between leaf nutrient status, and growth or yield. Chapman and Gray (10) state that their preliminary survey showed that the variation in ash percentage is seldom sufficient to give a significant difference between methods of expression. This may be so where the soil types are closely related, but examination of Figure I shows the great variations in percentage ash between soil types. There is little doubt, therefore, that when comparing the results of analyses on different soil types, expression on dry matter basis is preferable. This is shown by Table III:

Table III

Comparison of Analyses on Ash and Dry Basis

(a) Expression on ash basis (percentage)

Soil Type	P		K		Ca		Mg		Mn		Fe	
	F.1	F.17	F.1	F.17	F.1	F.17	F.1	F.17	F.1	F.17	F.1.	F.17
Coastal Clay	2.48	0.83	25.24	7.01	3.84	2.37	4.38	1.73	0.332	0.226	.055	.029
Upland Loam	3.25	1.91	27.12	14.76	4.26	4.77	5.66	3.64	0.122	0.107	.128	.091

(b) Expression on dry matter basis (percentage)

Soil Type	Ash		P		K		Ca		Mg		Mn (p.p.m)		Fe (p.p.m.)	
	F.1	F.17	F.1	F.17	F.1	F.17	F.1	F.17	F.1	F.17	F.1	F.17	F.1.	F.17
Coastal Clay	7.16	15.51	0.18	0.13	1.81	1.08	0.28	0.36	0.31	0.27	238	347	40	44
Upland Loam	5.80	8.15	0.19	0.15	1.58	1.19	0.24	0.40	0.32	0.29	70	85	74	71

F = Frond.

These analyses are from areas of six to seven year-old palms both yielding approximately 1,400 lb. of oil per acre per annum, one on coastal clay and the other on upland soil. The table shows that the two series of palms, giving the same yield, have similar analyses (except for Mn and Fe) when results are expressed on dry matter basis, even where the soils are completely different.

The variation in ash content is almost completely due to the silica

content. Table IV shows the amount of silica in the ash from the palms on the two different soil types. The high silica content in palms grown in coastal clay or peat is very interesting and may be a reflection of the moisture availability.

Table IV

Percentage Silica in Leaf Ash

Coastal Clay		Upland Loam	
F. 1	F. 17	F. 1	F. 17
40.80	81.20	23.32	58.36

Apart from less variation in samples from different soil types, when the results are expressed on a dry matter basis, it was also found that the variation was considerably less in samples from within a uniform area. To study this, advantage was taken of a set of analyses which had been carried out on an area of palms selected for a 2^5 manurial trial. These samples were taken before the fertilisers were applied and both the soil and palms were uniform. Each plot consisted of 25 palms of which ten were sampled. Table V shows the coefficient of variation, i.e., the standard error expressed as a percentage of the mean, when the results are expressed on ash and dry matter basis.

Table V

Coefficient of Variation when Nutrient Levels are Expressed on Dry Matter and Ash Basis

	Ash		P		K		Ca		Mg		Mn		Fe	
	F.1	F.17	F.1	F.17	F.1	F.17	F.1	F.17	F.1	F.17	F.1	F.17	F.1	F.17
Expressed on Ash Basis			5.2	19.0	3.0	13.4	32.5	19.7	8.1	30.1	14.6	13.9	11.0	12.3
Dry Matter	5.3	14.3	5.5	8.6	4.7	3.8	32.7	16.2	8.6	22.2	17.8	16.2	15.8	12.5

Table V indicates that the phosphorus, potassium and magnesium in frond 17 show less variation in an apparently uniform area when the results are expressed as percentage dry matter. This does not, of course, rule out the possibility that, when fertilisers are applied, their effects might appear different depending on how the results were expressed.

However, there is sufficient evidence to show that expression on dry matter basis is generally more satisfactory.

Factors Influencing Nutrient Levels

There are at least eight variables which should be examined when considering standardisation of sampling technique. These are:—

(i) Variations in composition between different parts of the same *pinnae*.
(ii) Variations in composition of the same section of *pinnae* in different parts of the same frond.
(iii) Variations in composition between different fronds, as determined by sampling a definite section of a definite *pinnae* from each frond.
(vi) Variations with time of day.
(v) Variations due to age of palms.
(vi) Variations due to variety.
(vii) Variations due to fruiting cycle.
(viii) Variations due to soil type.

Factors (i) and (ii) were examined by Chapman and Gray and their technique has been used. The other variables were studied in the present investigation and a brief outline of the results is given below.

Age of frond.

In their investigation Chapman and Gray noted that the correlation between yield and P_2O_5 or K_2O levels in the frond was only found in the older fronds. Broeshart (2) used fronds 1 and 9, while Scheidecker and Prevot (19) used the first or youngest leaf to have reached full size. Broeshart (5) later suggests different leaves for different nutrients.

To study the variations in nutrient level with frond age, fronds 1, 9, 17 and 25 were sampled (1 being the youngest fully opened frond). Samples were obtained from old palms on peat, coastal clay and poor upland soil and from young palms on coastal clay. The results are shown in Figure I and these show the following trends:—

N A slight increase from frond 1 to frond 9 and then a decrease.

Ash There is a steep increase with age of frond except in the case of the upland soil where the increase is only slight.

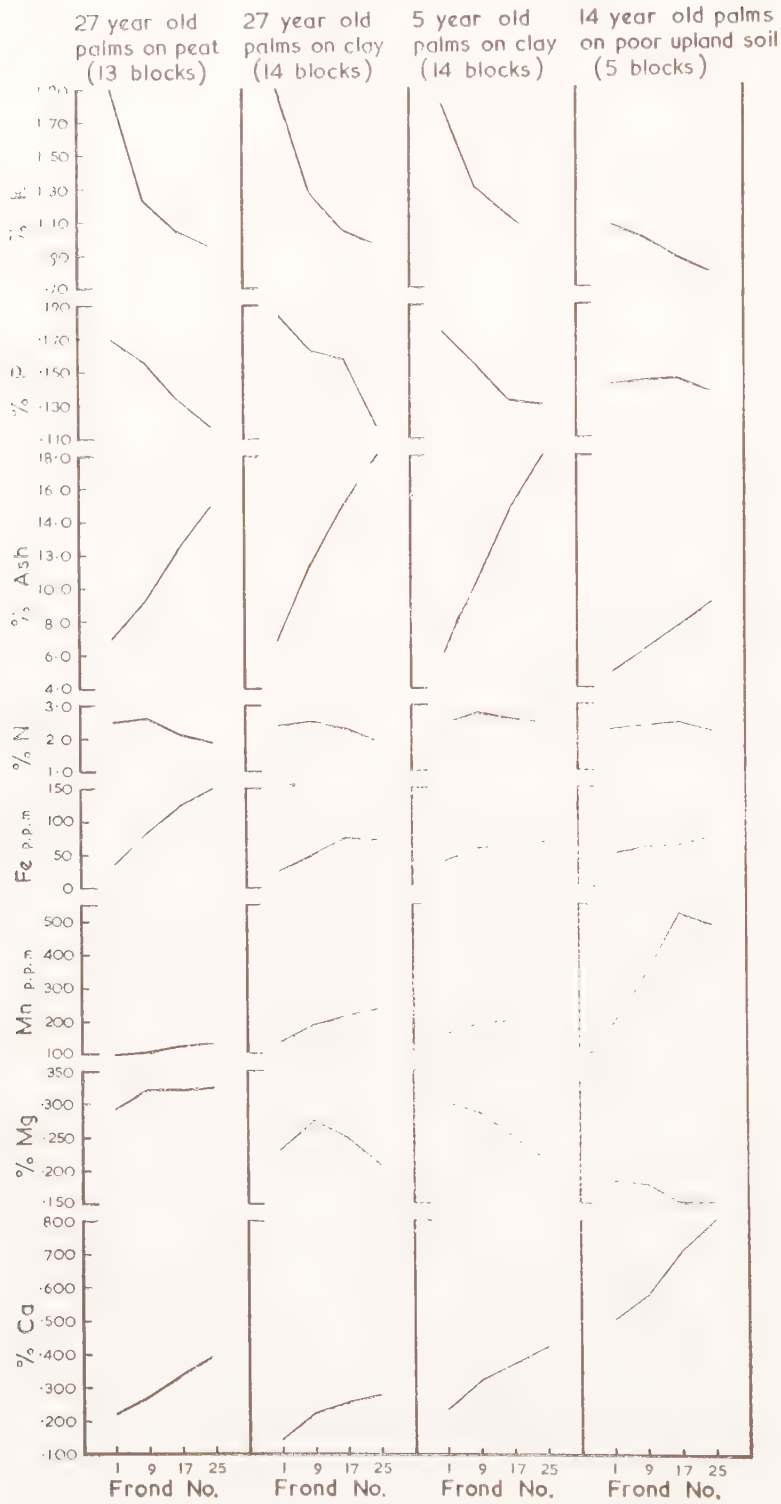
P There is a marked drop with increasing age of frond except for the upland soil. Thus it appears that where the supply of phosphorus is plentiful there is a marked difference beween the young and old fronds.

K Again there is a marked drop with increasing age, but where the potassium is already low, as in the upland soil, the drop is comparatively small.

Ca This increases with increasing age, the increase being most marked in the case of the palms on upland soils.

FIGURE I

Variation in Nutrient Level with Frond Age.


27 year old palms on peat (13 blocks)
27 year old palms on clay (14 blocks)
5 year old palms on clay (14 blocks)
14 year old palms on poor upland soil (5 blocks)
% K
% P
% Ash
% N
Fe p.p.m
Mn p.p.m
% Mg
% Ca
1 9 17 25
Frond No.

Mg Where the supply is ample there is an increase from frond 1 to frond 9 and a constant level thereafter. Where magnesium is in short supply, there is a decrease with age, frond 9 being lower than frond 1.

Mn Where the supply is low, there is very little increase with age. There is an extremely large increase with age in the case of palms on upland soils, i.e., where levels are high.

Fe There is a considerable increase with age where manganese is in short supply, otherwise there is little increase.

These findings indicate that the difference in levels between young and old fronds could be of use for diagnostic purposes, particularly for magnesium and manganese; thus throughout the investigation both fronds 1 and 17 were sampled.

TIME OF DAY.

This was investigated by sampling 10 individual palms at 10.30 a.m. and again at 5.30 p.m. Table VI gives the levels of the various nutrients in fronds 1 and 17 at the two sampling times.

Table VI

Variation in Nutrient Levels with Time of Day

Nutrient	Frond 1		Frond 17	
	10.30 a.m.	5.30 p.m.	10.30 a.m.	5.30 p.m.
per cent D.M.				
N	1.99	1.89 **	2.21	2.09 **
Ash	5.16	5.52 **	7.05	6.90 *
P	0.17	0.17	0.14	0.14
K	1.71	1.67	1.11	1.13
Ca	0.47	0.44	0.67	0.61 **
Mg	0.22	0.21	0.16	0.15 *
p.p.m. D.M.				
Mn	210	204 *	457	428 *
Fe	41	41	65	69

* Significant at 5% point (Difference between times)
** Significant at 1% point.

This shows a highly significant drop in nitrogen in both fronds 1 and 17 between morning and evening sampling. There is also a drop in calcium, magnesium and manganese and an increase in ash in frond 1. It is of interest to note that the percentage drop for calcium in frond 17 is 8.9 per cent and for magnesium 6.2 per cent. whereas it is only 5.4 per cent for nitrogen. To minimise these variations the fronds should be sampled within fairly narrow daily time limits, and 8 a.m. to 12 noon was the period used.

VARIETY.

Preliminary work by Coulter and Rosenquist showed that there was a considerable variation between selections. A further series of samples was taken from the five families in a progeny trial at the Federal Experiment Station, Serdang, and the results are shown in

Table VII. Each family, in each of five blocks, consists of one row of 10 palms.

Table VII

Variation in Nutrient Level with Variety
(On Dry Matter Basis)

Nutrient	Frond No.	Family					S.E. of Means
As per cent		E.268	E.207	E.97	E.152	E.216	
N	1	2.11	2.24	2.07	2.26	2.15	± 0.029
	17	2.17	2.24	2.07	2.13	2.15	± 0.029
Ash	1	5.96	5.79	6.25	6.20	5.91	± 0.088
	17	8.63	8.16	9.41	9.87	9.61	± 0.239
P	1	0.193	0.215	0.208	0.223	0.211	± 0.0054
	17	0.157	0.176	0.167	0.167	0.160	± 0.0054
K	1	1.560	1.402	1.588	1.499	1.593	± 0.0442
	17	0.886	0.937	1.281	1.038	1.156	± 0.0360
Ca	1	0.506	0.529	0.567	0.565	0.495	± 0.0135
	17	0.867	0.793	0.638	0.772	0.679	± 0.0336
Mg	1	0.205	0.207	0.214	0.220	0.208	± 0.0049
	17	0.162	0.139	0.097	0.119	0.136	± 0.0073
As p.p.m.							
Mn	1	224	231	225	239	226	± 10.2
	17	508	428	357	384	416	± 27.4
Fe	1	45.7	42.5	42.3	48.2	41.6	± 3.85
	17	65.7	60.3	64.7	68.3	69.2	± 3.08
Yield (lb. of bunches/acre/ann.) (1956)		9390	5070	5350	5310	8440	

It will be seen from this table that frond 17 of E.97 is high in potassium and low in magnesium and calcium while frond 1 and 17 are low in nitrogen and the manganese in frond 17 is also low.

Samples were also taken from a Dumpy v Tall progeny trial on coastal clay and the results are given in Table VIII.

Table VIII

Nutrient Levels in Frond 17 of Dumpy and Tall Palms
(On Dry Matter Basis)

Nutrient	Dumpy	Tall	S.E. of difference between means (23 d. of f.)
As per cent			
N	2.13	2.32	± 0.053
Ash	8.94	9.52	± 0.322
P	0.155	0.161	± 0.0036
K	0.921	0.910	± 0.030
Ca	0.377	0.417	± 0.0162
Mg	0.376	0.414	± 0.0174
As p.p.m.			
Mn	296	289	± 17.1
Fe	65.6	57.4	± 3.23

These results show that frond 17 of Tall palms is significantly higher in nitrogen, calcium and magnesium and lower in iron than Dumpy palms. These differences are probably unimportant in rich coastal clays but might be of importance in the poorer inland soils.

Another interesting aspect of the differences in varietal reaction to uptake of nutrients is the question of selection on different soil types. Cases have been encountered where palms, selected for their high yielding properties on rather poor inland soils have, when planted on rich coastal clay, produced a superfluity of female flowers, while other unselected palms growing alongside have produced normal sex ratios.

AGE OF PALMS.

This problem has been investigated by Broeshart (4) who concluded that the only apparent differences were in magnesium and ash content. In his experiments he was able to sample palms of different ages growing under the same conditions, the young palms being replants. In our investigation there was no such opportunity and to study the problem the results of analyses for palms of different ages on different soils were grouped into five age groups, viz., palms 25 years and over, 20 to 24 years, 15 to 19 years, 5 to 10 years and under 5 years (no planting took place between 1940 and 1945). Results are summarised in Table IX.

Table IX

Variation in Nutrient Level with Age of Palm

	N		Ash		P		K		Ca		Mg		Fe		Mn	
	F.1	F.17	F.1	F.17	F.1	F.17	F.1	F.17	F.1	F.17	F.1	F.17	F.1	F.17	F.1	F.17
Coastal Clay	—	—	°	+	—	—	°	—	°	—	+	+	°	°	°	+
Peat	+	—	—	—	°	—	—	—	+	+	+	+	°	°	°	+
Upland Soil	—	—	°	+	°	+	—	—	—	—	+	+	°	—	°	°

+ increase with age, — decrease with age, ° no change.

This table can only be regarded as giving an indication of the trend as palms get older; nevertheless, it shows that there is a general decrease in potassium with age while magnesium increases. Nitrogen also shows a general decrease with age. One possible interpretation of these results is that older palms generally need potassium and nitrogen manuring. Alternatively, it may mean that the "critical levels" are higher for magnesium and lower for potassium and nitrogen in the older palms.

FRUITING CYCLE.

To study the influence of the fruiting cycle on frond nutrient levels ten palms at the Federal Experiment Station, Serdang, were

selected and frond 17 of each was sampled at approximately fortnightly intervals. Records of the production of male or female flowers and harvesting of fruit bunches were kept. Analyses and records were carried out for 24 consecutive months, and these included determinations of nitrogen, ash, phosphorus, potassium, calcium and magnesium. Phosphorus showed the least variation of any of the nutrients. Magnesium also showed comparatively uniform levels during the period of examination. Calcium varied considerably more and although the variations were erratic, the levels tended to be higher during periods of higher bunch production. The greatest variations were shown by potassium and nitrogen. Potassium levels were generally lowest at, or just before the time, a bunch was harvested. After the harvest levels rose fairly rapidly. Results were not always consistent, however, and low potassium levels were recorded when bunches were still unripe. Nitrogen appeared to vary without any consistent features and it is possible that it is influenced by moisture conditions more than the other nutrients. Although sampling a number of palms should help to level out the differences due to the fruiting cycle, it is possible that at periods of high productivity potassium levels may be generally lowered.

Recommended Sampling Procedure

On the results of the above experiments it is possible to recommend a sampling procedure which is as follows: At least ten palms should be included in one sample (to take into account variations due to fruiting, etc.) and samples taken between 8 a.m. and 12 noon to allow for the daily variation in nutrient levels. Since certain deficiencies, particularly magnesium and manganese, show up better in the older fronds and the difference in levels between the older and younger fronds is important, both frond 1 and frond 17 should be sampled. In sampling a frond the central two pairs of *pinnae* should be taken and for the chemical analyses the middle four inches of the *pinnae*, with the mid-rib removed, should be used. Generally it is best to express the levels on a dry matter basis as this makes results from different soil types more directly comparable.

Advisory Work Based on Foliar Analyses

In order to use frond analyses as a practical basis for manurial advisory work, it is necessary to decide on "optimum levels" for the various nutrients. Workers in French West Africa and the Belgian Congo have put forward what they term "critical levels" while Chapman and Gray have suggested a $K_2O : P_2O_5$ ratio. The levels of the various nutrients are inter-dependent and it has been shown by Broeshart (6) that in sand culture, deficiency of one nutrient could induce a deficiency of another. He also states that palms with an adequate supply of plant nutrients, whether growing in soil or sand culture, have a 'normal' leaf composition. However, our experience with other crops suggests that

nutrient supply in sand culture can lead to luxury consumption and oil palms probably react in the same way.

Levels obtained from frond analyses of palms in factorial manurial experiments are the most accurate bases for determining "optimum values". Such experiments are, however, not available on certain soils and in these cases values obtained from healthy high-yielding palms growing under commercial conditions have been obtained.

YOUNG PALMS ON COASTAL CLAY.

Leaf samples were obtained from a 2^4 manurial experiment on coastal clay, the dressings being ½ lb. sulphate of ammonia, 1 lb. Christmas Island Rock Phosphate, ½ lb. muriate of potash and ½ lb. of kieserite per annum at 0 and 1 levels. The palms were planted in 1950 and manured annually from 1951. Leaf samples were taken in 1956, in which year the yield was 3,400 lb. of oil per acre. Table X gives the results of leaf analyses.

Table X

Nutrient Levels in 2^4 Manurial Experiment

Nutrient	Frond 1		Frond 17	
	Average	S.E. % of mean	Average	S.E. % of mean
Per cent D.M.				
N	2.48	2.9	2.67	2.8
Ash	5.87	5.4	9.93	8.1
P	0.21	6.3	0.19	2.8
K	1.70	6.8	1.21	4.2
Ca	0.25	28.1	0.41	22.6
Mg	0.29	9.2	0.29	7.6

The effect of manuring on yield or nutrient levels in the fronds was not significant.

These results can be compared with those from a 50-acre block on an estate on coastal clay, where palms planted in 1950 gave 3,300 lb. per acre of oil in 1956. The leaf analysis for these palms is given in Table XI.,

Table XI

Nutrient Levels in High Yielding 6 Year Old Palms on Coastal Clay

Nutrient	Frond 1	Frond 17
Per cent D.M.		
N	2.45	2.63
P	0.19	0.15
K	1.88	1.06
Ca	0.28	0.43
Mg	0.30	0.27
As p.p.m.		
Fe	36	46
Mn	242	419

Based on these results the 'optimum' levels for young palms on coastal clay are given in Table XII.

Table XII

Tentative 'Optimum Levels' for Young Palms on Coastal Clay

	Frond 1			Frond 17		
Per cent D.M.						
N	2.45	—	2.50	2.60	—	2.70
P	0.18	—	0.20	0.15	—	0.17
K	1.70	—	1.80	1.10	—	1.20
Ca	0.25	—	0.27	0.40	—	0.45
Mg	0.28	—	0.30	0.27	—	0.29
As p.p.m.						
Fe	40	—	50	50	—	60
Mn	150	—	200	250	—	350

YOUNG PALMS ON UPLAND SOILS.

No factorial manurial experiments on palms on upland soils were available for examination. However, on one estate an area planted in early 1949 on upland sandy loam yielded 1,400 lb. per acre of oil in 1954. From 1950 to 1953 the annual dressings of fertilisers were NPK (up to 3 lb. per palm in 1953) and in 1954 4 lb. of CIRP. The leaf samples were taken and results of analyses are given in Table XIII.

Table XIII

Nutrient Levels in 6 Year Old Palms on Upland Sandy Loam

Average Nutrient level	Frond 1	Frond 17
Per cent D.M.		
N	2.44	2.54
P	0.20	0.17
K	1.43	1.01
Ca	0.36	0.61
Mg	0.19	0.11
As p.p.m.		
Fe	53	87
Mn	137	197

The main differences between these and palms on coastal clay are the much higher calcium and lower magnesium in the palms on upland soils. It is also of interest to note that the frond 1/17 ratio for magnesium is 1.73 for upland soils, whereas it is only about 1.0 for palms on coastal clay. It seems to be an important feature of magnesium deficiency that the frond 1/17 ratio is high where the nutrient is in short supply. There is evidence that the magnesium levels given in Table XIII are too low, other evidence suggests levels of the order given in Table XIV.

Table XIV

Tentative 'Optimum Levels' for Young Palms on Upland Soils

Nutrient	Frond 1			Frond 17		
Per cent D.M.						
N	2.45	—	2.50	2.50	—	2.60
P	0.17	—	0.18	0.15	—	0.17
K	1.50	—	1.60	1.00	—	1.10
Ca	0.40	—	0.50	0.60	—	0.70
Mg	0.24	—	0.25	0.23	—	0.25
As p.p.m.						
Fe	40	—	50	80	—	100
Mn	150	—	200	200	—	300

OLD PALMS ON COASTAL CLAY.

In general, old palms on coastal clay yield well for many years. Table XV gives the results of analyses for a field of 140 acres planted in 1927 which in 1956 gave 2,200 lb. of oil per acre.

Table XV

Nutrient Levels in Old Palms on Coastal Clay

Nutrient	Frond 1	Frond 17
Per cent D.M.		
N	2.48	2.32
P	0.19	0.16
K	1.86	1.05
Ca	0.14	0.26
Mg	0.23	0.25
As p.p.m.		
Fe	27	76
Mn	139	224

These values are of the same order as those obtained for a number of other good yielding old palms on coastal clay. Tentative 'optimum levels' for old palms on coastal clay are given in Table XVI.

Table XVI

Tentative 'Optimum Levels' for Old Palms on Coastal Clay

Nutrient	Frond 1			Frond 17		
Per cent D.M.						
N	2.45	—	2.50	2.50	—	2.60
P	0.18	—	0.19	0.15	—	0.17
K	1.60	—	1.80	1.00	—	1.10
Ca	0.16	—	0.18	0.25	—	0.30
Mg	0.25	—	0.26	0.25	—	0.26
As p.p.m.						
Fe	40	—	45	50	—	60
Mn	150	—	200	200	—	300

Old Palms on Upland Soils.

On the upland soils yields of the older palms are generally lower and the average yield is something of the order of 1,500 lb. oil per acre per annum. Some areas, however, yield better and one such area of 1938/39 planting, giving an average yield for the years 1950/54 of 2,400 lb. of oil per acre, was chosen. During this period the palms had been manured with sulphate of ammonia, muriate of potash and magnesium limestone. The results of leaf analyses, carried out in 1955, are given in Table XVII.

Table XVII

Nutrient Levels in Old Palms on Upland Soils

Nutrient	Frond 1	Frond 17
Per cent D.M.		
N	2.48	2.52
P	0.17	0.15
K	1.45	0.86
Ca	0.44	0.71
Mg	0.24	0.19
As p.p.m.		
Fe	48	118
Mn	176	327

Apart from slightly lower potassium and magnesium and much higher calcium the figures are similar to those for the coastal clays. Tentative 'optimum levels' for old palms on upland soils are given in Table XVIII.

Table XVIII

Tentative 'Optimum Levels' for Old Palms on Upland Soils

Nutrient	Frond 1			Frond 17		
Per cent D.M.						
N	2.45	—	2.50	2.50	—	2.60
P	0.17	—	0.18	0.15	—	0.17
K	1.50	—	1.60	0.90	—	1.00
Ca	0.40	—	0.50	0.60	....	0.70
Mg	0.24	—	0.25	0.23	—	0.25
As p.p.m.						
Fe	40	—	50	100	—	120
Mn	150	—	200	250	—	350

For peat soils it is suggested that standards similar to those for coastal clays be adopted.

Discussion

As mentioned in the introduction, a number of workers both in Africa and Malaya have set standards by which the nutritive status of oil palms can be judged, and it is of interest to compare their standards with those set in this paper. Chapman and Grey, who were concerned

mainly with potassium and phosphorus nutrition, set as the optimum, a K_2O/P_2O_5 ratio of 2.5 to 3.5 (their R Value). The standards set in this paper would give R values in the range of 3.1 for old palms on upland soils, to 3.8 for young palms on coastal clay.

It is also of interest to compare these results with the optimum values suggested by African workers. Scheidecker and Prevot (19) suggest the following "critical levels" for the nutrients.

N	....	....	2.75 per cent
P	....	....	0.15 „ „
K	....	....	1.00 „ „
Ca	....	....	0.60 „ „
Mg	....	....	0.24 „ „

It is difficult to compare these directly with Malayan results, since the age of the frond is not given. The authors state that for each palm they took one of the first leaves to have reached its full size. Thus their samples would be older than frond 1 but not as old as frond 17. These standards are very considerably lower in potassium and higher in calcium and nitrogen than those for Malaya. Prevot and Ollagnier (18) using the first healthy, fully-opened leaf, gave similar values for critical levels, except that they put the nitrogen level at 3.0 per cent. Broeshart using the first fully-opened leaf gives the following values for high-producing blocks in the Belgian Congo.

K	....	1.7	—	1.9	per cent
Ca	....	0.55	—	0.65	„ „
Mg	....	0.25	—	0.35	„ „
P	....	0.21	—	0.23	„ „

These, with the exception of calcium, are much closer to the Malayan values.

During the course of this investigation about 320 blocks of oil palms were sampled and many others have also been sampled during advisory visits. Thus a considerable amount of information has been accumulated on the nutrient status of Malayan oil palms and a brief summary of this information is given below.

Nitrogen

Levels in Malayan palms are lower than those given for palms in Africa. However, none of the experiments recorded in Malaya (22) showed economic responses to nitrogen: this has also been recorded by Haines and Benzian in Africa. Certain estates have reported benefits from manuring old palms with nitrogen but no detailed evidence is available. There is, however, a factor which has probably been overlooked in the past and that is the supply of magnesium. The present series of leaf analyses has shown that magnesium can be quite low, especially on upland soils, and it is a well known fact that the NH_4 ion depresses the uptake of magnesium. It is therefore quite possible that, where the supply of magnesium is marginal or deficient, application of ammonium sulphate would not be beneficial. In these circumstances

the effect of nitrogenous manuring when magnesium is in ample supply needs further examination. It has also been shown that applying nitrogen to young replanted palms gives increased and uniform growth.

Phosphorus

Phosphorus, in the form of rock phosphate, is the one fertiliser which has been almost universally applied to oil palms, regardless of soil type. Though some Malayan soils are very low in phosphorus, the present survey has shown that most palms had optimum levels in the fronds, probably the result of regular application of phosphates.

Potassium

Palms on coastal clay are generally well supplied with potassium but deficiencies do appear in upland soils and some palms, especially those which had been manured with rock phosphate only, showed low potassium levels in the fronds.

Magnesium

The situation as regards magnesium was mentioned when nitrogen supply was discussed. Leaf analyses and the 'yellowing' of the fronds which is frequently noted indicate that magnesium is often in short supply for oil palms, and this seems to be particularly the case in upland soils. On the coastal clays there is less evidence of such deficiencies but since oil producing plants have a higher requirement for magnesium than other plants, it is possible that magnesium deficiency can occur on these soils also. It is also possible that as replanted acreages increase, magnesium deficiency symptoms will also increase as has been the case for rubber (1).

The need for magnesium for oil palms in Malaya is now generally recognised and two magnesium fertilisers, ground dolomitic limestone and kieserite (magnesium sulphate) are marketed. The former is locally available and therefore cheaper. Experiments in Florida (9) on citrus showed that where the pH was 4.5 to 5.0, a range slightly above that in Malaya, dolomite failed to give good results the first year but was effective the second year, whereas the soluble magnesium fertiliser gave good results almost immediately. It is possible, therefore, that in the upland soils of Malaya a soluble magnesium fertiliser should be given but it could be supplemented with dolomitic limestone to supply the subsequent needs for magnesium. In the damper and slightly more acid coastal clays, the insoluble form is probably more readily available but in cases of acute magnesium deficiency application of the soluble form would be helpful.

Calcium

Judged by the levels of calcium in the fronds of high-yielding palms on coastal clay, the oil palm's requirement for calcium is low and in fact too much calcium is possibly harmful in that it depresses potassium uptake. The low requirement for calcium is illustrated in an experiment

by Broeshart *et al* (8) in which they failed to obtain symptoms of calcium deficiency when calcium was omitted from a sand culture, even though deficiencies of the other major elements could be induced quite easily by this technique. This finding has also been confirmed by experiments in Nigeria. Malayan soils are very low in calcium and it is thus fortunate that the oil palm's requirement is small.

Manganese

The manganese requirements of the oil palms have not yet been established but leaf analysis from a plot of six year old palms grown on peat indicates that deficiency of manganese is a distinct possibility on such soils. The level of manganese in the leaves of these palms is of the order of 50 p.p.m. as compared with 150-200 p.p.m. in healthy palms on coastal clay. The palms were poorly grown and suffered from severe "yellowing" which was not improved by heavy dressings of magnesium. Dressings of up to 3 lb. per palm of manganese sulphate had no visible effect after six months. If palms are suffering from manganese deficiency it is probable that the deficiency would be accentuated by addition of magnesium. It is thus desirable that the possibilities of manganese deficiency in oil palms on peaty soils should be investigated further.

Iron

The levels of iron in palms on different soil types are generally fairly uniform, though there is a suggestion that where levels of manganese are very low iron levels increase. The survey did not give any evidence of iron deficiencies in oil palms.

Other Trace Elements

Routine methods have not been worked out for determination of other trace elements and though it is stated that boron deficiency occurs on oil palms in the Congo, no evidence has been found for such a deficiency.

It will be seen from this survey that potassium and magnesium are the fertilisers most often needed for oil palms in Malaya. It also shows that the nitrogen requirements need re-examination and that manganese deficiency on peat soils is possible.

Summary

A description is given of the major types of soil on which oil palms are grown in Malaya and the problem of applying foliar analyses to the determination of the nutrient status of the palm is discussed. The various factors affecting the levels of nutrients in the frond are examined and it is shown that age of frond, soil type, time of day and variety, all have an influence on nutrient levels. The variation in levels of nutrients from a uniform area are compared on dry matter and ash basis and it is noted that expression on a dry matter basis is preferable. It was found that the nature of the soil had a very marked effect on the levels of ash and calcium in the fronds.

From the results of this survey tentative "optimum" levels of the major elements and the minor elements, manganese and iron, are set for old and young palms on different soil types. These levels are proposed as standards for advisory purposes and they are shown to be in the same range as the standards proposed for oil palms in Africa

The survey has shown that potassium and magnesium are the most likely nutrients to be deficient but that the lack of response to nitrogen in past experiments is possibly due to the shortage of magnesium. It also shows that there is a distinct possibility of manganese deficiency on peat soils.

Acknowledgements

The writer wishes to thank those estate managers who gave permission for leaf samples to be taken and provided records of yields and manurial treatments. Particular thanks are due to Mr. S. Thamboo, Assistant Research Officer, who was responsible for all the sampling and analytical work and Mr. I. Watson for carrying out statistical analyses.

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A NOTE ON FUNGICIDAL SEED DRESSING OF SOYA BEAN, GROUNDNUT AND LONG BEAN

BY

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Introduction

In botanical trials carried out at the Federal Experiment Station, Serdang, poor germination of soya beans (*Glycine max*) has often been encountered, resulting in patchy growth of the crop. To discover whether germination could be improved by treating the seeds with a fungicide the pot experiments described in the following note were carried out. On completion of the tests on this crop, in view of the beneficial results obtained by seed treatment, similar experiments were carried out using groundnuts (*Arachis hypogaea*) and long beans (*Vigna sinensis*), to discover whether the results obtained with soya beans were likely to be applicable to other leguminous crops.

Methods

In all the experiments seeds were planted in 8-inch pots of unsterilised soil, 50 seeds in each pot. The pots were kept in the open but were protected from rain until germination had begun. The number of seeds germinated was checked ten to 14 days after planting.

All the fungicides used were in the form of dusts. In the first test on soya bean the dressings used were Agrosan GN (a mercurial preparation), Mergamma B (a combined fungicide and insecticide containing a mercurial preparation and BHC), Fernasan (active ingredient thiram) and Flit 406 (active ingredient captan). In all subsequent tests Agrosan GN, Fernasan and Flit 406 were incorporated but Mergamma B was omitted. Two additional materials were added, viz. Spergon (active ingredient chloranil) and Tritoftorol (active ingredient zineb). Of these materials, Agrosan GN, Mergamma B, Fernasan and Spergon are formulated specifically as seed dressings, whereas Flit 406 and Tritoftorol are primarily designed as foliage sprays. All were used at the rate of 0.1 gm. seed dressing for every 30 gm. seeds, the dressing being applied to the seeds by shaking seeds and dressing together for a few minutes in a closed jar. Seeds were planted 24 hours after treatment.

Two experiments were carried out on each crop. The design in all cases was a randomised block, with four replications in the first soya bean test and six in all the others. Each plot consisted of one pot containing 50 seeds.

Seed Treatment Experiments

SOYA BEAN

In both tests on soya bean improvement in germination became visible in several treatments soon after the seedlings appeared above ground (Plate I). This observation was confirmed by the germination counts, summarised in Table I.

Germination of untreated soya beans.

Germination of soya beans treated with captan.

Table I

Effect of Seed Dressing on Germination of Soya Beans
Figures Show Mean Number Germinating per Plot of 50 Seeds

Treatment	Expt. S 1		Expt. S 2	
	Germination	Increase over untreated	Germination	Increase over untreated
Agrosan GN	36.0	15.2 **	34.2	18.7 ***
Mergamma B	33.0	12.2 **	—	—
Spergon	—	—	37.5	22.0 ***
Fernasan	22.3	1.5	42.0	26.5 ***
Flit 406	31.5	10.7 *	38.7	23.2 ***
Tritoftoral	—	—	41.0	25.5 ***
No treatment	20.8	—	15.5	—
Standard Error	3.57		2.92	

Significance at 5%, 1% and 0.1% indicated by *, ** and *** respectively.

In the first test all treatments except Fernasan gave significant increases in germination. In the second test all treatments gave significant increases, the number of seeds germinating being in all cases more than doubled by the dressing.

GROUNDNUT

As in the case of soya bean it became evident soon after the seedlings appeared that germination of untreated seed was visibly poorer in most cases than germination of treated seed. In the first few days germination appeared to be hastened in the first experiment by Spergon and Fernasan and in the second by Agrosan GN and Fernasan. In neither test did treatment with Tritoftorol visibly improve germination. Table II summarises the results of these tests.

Table II

Effect of Seed Dressing on Germination of Groundnuts
Figures Show Mean Number Germinating per Plot of 50 Seeds

Treatment	Expt. G 1		Expt. G 2	
	Germination	Increase over untreated	Germination	Increase over untreated
Agrosan GN	32.8	14.1 ***	27.2	14.4 ***
Spergon	33.0	14.3 ***	27.3	14.5 ***
Fernasan	32.8	14.1 ***	28.7	15.9 ***
Flit 406	33.0	14.3 ***	29.3	16.5 ***
Tritoftoral	24.2	5.5	17.7	4.9
No treatment	18.7	—	12.8	—
Standard Error	3.06		3.06	

Significance at 0.1% indicated by ***.

In both tests all treatments except Tritoftorol gave highly significant increases in the number of seeds germinating.

LONG BEAN

From observation no differences in germination could be detected between treatments in these tests. This general lack of response to seed dressing was also shown by germination counts (Table III).

Table III

Effect of Seed Dressing on Germination of Long Beans
Figures Show Mean Number Germinating per Plot of 50 Seeds

Treatment	Expt. L 1		Expt. L 2	
	Germination	Increase over untreated	Germination	Increase over untreated
Agrosan GN	42.0	0.7	38.3	2.3
Spergon	43.3	2.0	34.7	—1.3
Fernasan	45.7	4.4 *	37.2	1.2
Flit 406	40.7	—0.6	36.0	0
Tritoftoral	39.5	—1.8	34.5	—1.5
No treatment	41.3	—	36.0	—
Standard Error	3.5		4.3	

Significance at 5% indicated by *.

Only one treatment (Fernasan) gave a significant increase in germination in one test.

Discussion

The experiments described above are of a preliminary nature and too limited in scope for general conclusions to be drawn, but they give an indication that in at least some cases treatment of leguminous seeds with fungicides may be beneficial. In the tests on soya beans and groundnuts the most successful treatments resulted in increases in germination of 53 per cent and 33 per cent respectively; if such results are found to be normal and to occur in the field, seed treatment of these crops would be well worth carrying out. On the other hand, long beans did not respond to treatment.

All the fungicides tested gave satisfactory results except Tritoftorol. The others gave equally good results but the non-mercurials have the advantage of low mammalian toxicity and are therefore safer to use.

Why fungicidal seed dressing gives improved germination on these crops has not been investigated, but in the case of soya beans the cause of poor germination of untreated seeds would appear to be pre-emergence damping off due to micro-organisms in the soil. This was indicated by the fact that seeds grown in steam sterilised soil germinated better

than those grown in unsterilised soil, the effect of sterilising the soil being similar to the effect of applying a seed dressing.

Summary

Experiments on treating soya beans, groundnuts and long beans with a fungicidal seed dressing showed that in the case of soya bean and groundnut substantial increases in the number of seeds germinating could be obtained by using an organic mercurial dressing or materials containing chloranil, thiram, captan or zineb. Treatment of long beans had little beneficial effect.

Acknowledgements

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DRY SEASON CULTIVATION OF VEGETABLES AND FOODCROPS ON ISLANDS AND RIVERBANKS IN KELANTAN

BY

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Introduction

The cultivation of islands and flood plains in Kelantan during the dry season for the production of vegetables and foodcrops is no new development, but during the past few years its extent has been increased particularly in Kota Bharu, Tumpat and Machang Districts where much of the padi land has been inter-cropped. The use of islands, riverbanks and flood plains for this purpose involves a markedly different practice from the rest of the Federation. The exact extent of the area planted annually is not easily ascertained, but a conservative estimate is about 2,500 acres. (Map I).

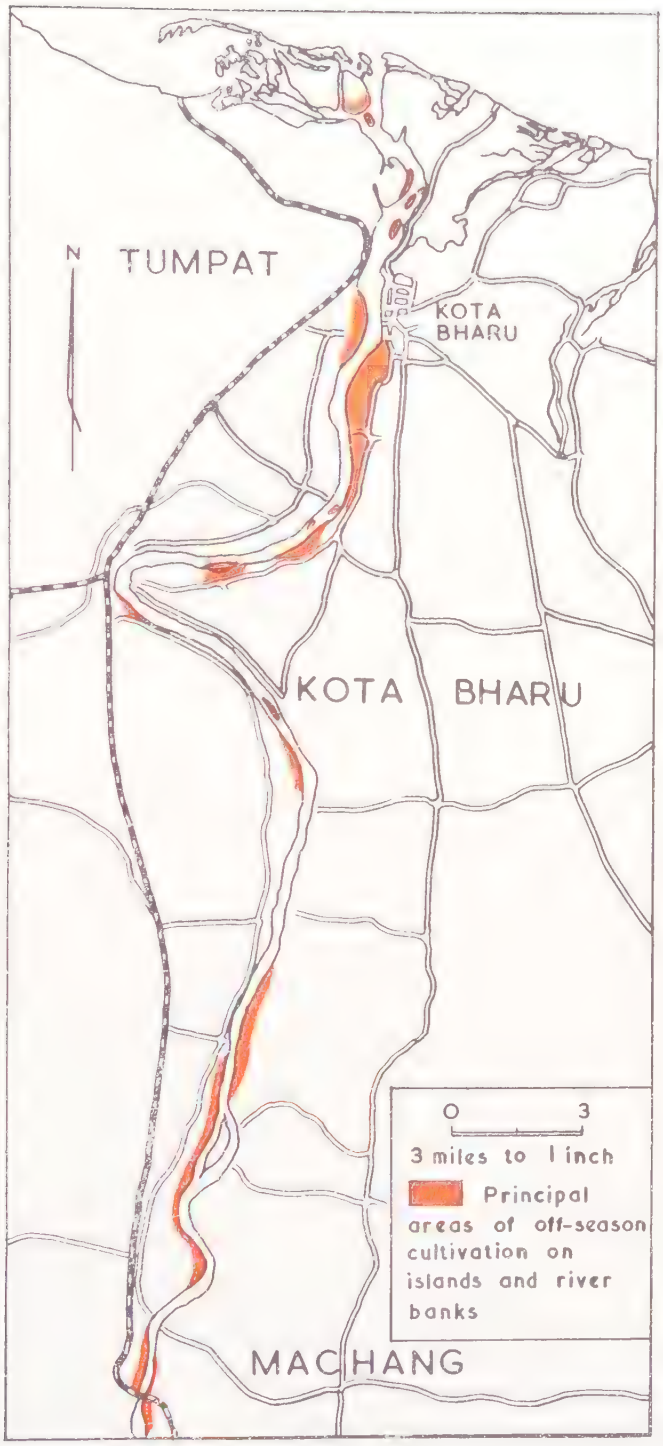
The reasons why this type of off-season cultivation is more extensive in Kelantan than elsewhere is the availability of large areas of alluvial deposits left after the monsoonal floodwaters have receded. Normally, the north-east monsoon rains cease about the middle or end of January, having once or twice and sometimes three times flooded the islands and plains for varying periods. Moreover, the general low level of income from their main crops—small padi and *dusun* (orchard) lots with comparatively low yields—has caused the Kelantan farmers to try and obtain an additional income during the off-season from vegetable cultivation. In addition to the islands, river banks and flood plains, a considerable acreage of the inland padi areas are annually cropped with various vegetables, tobacco and, to some extent, sugar-cane in the off-season.

Rents

The main areas of islands and flood plains where this dry season cultivation is practised are shown on the map. They are either State or alienated land. The former is cropped by farmers who obtain the right by lease on Temporary Occupation Licence; sub-leasings do occur but are gradually dying out. The alienated land mostly belongs to well-to-do individuals or Royal families and, as a result, is cultivated more by tenant-farmers than by owner-farmers.

At the end of each year, auction notices with sketch maps of State land comprising islands, flood plains and river banks are put up by the respective District Offices concerned. The dates and localities where the auction will take place are specified in this notice. Those who have an interest in the land will assemble at the appointed place. Normally,

MAP I



Principle areas of cultivation on the islands and river banks of the Sungei Kelantan.

PLATE I

Cultivation for groundnuts and maize in February/March.

PLATE II

Watermelons (Temikai or Timun China) three weeks after transplanting.

before they come to an auction, the farmers have already met and settled among themselves as to the price for the rent and who will bid for a particular site. This prevents the bidding prices from going higher and higher each year, and also helps a farmer to retain the same piece of land he worked previously. Where there is no mutual understanding between the farmers or a clash of interest exists, bidding prices usually go up very sharply. The size of each lot varies a great deal—anything from one-eigth to three acres and sometimes more. The bidding price may be from $2 to as much as $200 per acre.

The following are examples of bidding prices or rent per annum paid by farmers in 1957 for State land:—

Locality	Area (acre)	Rent ($)	Approximate rent per acre ($)
Pasir Mas	0.89	61	68
	1.105	20	18
	1.181	2.50	2
	0.2	20	100
Tumpat	2.2	710	323
	1.4	130	93
	1.2	150	125
Tanah Merah	0.3	5.50	18
	0.2	6.50	33
	0.3	21	70

The above are a few samples of rent taken at random.

During pre-war days land speculators would attend the auction and try to get as much of the area as possible. The result was, of course, that the rents were very high and eventually the land was subdivided and sub-leased at an even higher rate. This practice of sub-leasing for immediate gain, however, appears to be dying out.

Briefly, the system of sub-leasing either State or alienated land is for the man who has obtained the right to the land to mark it out into several small lots. A single lot is called *satu galah*. The width may be 1 to 1½ chains depending on the bamboo pole (the word *galah* means a long piece of bamboo used for picking fruits) and the length 2 to 4 chains. The rent varies considerably depending on the fertility of the soil and close proximity to water supply. The average rent per *galah* may be $20 to $40 and sometimes even higher. A family cultivates on the average three to four lots of this size, roughly equivalent to 1½ to 2½ acres.

Alienated lands subjected to annual flooding along the Kelantan River and privately owned islands are almost all used for off-season cultivation. The people who cultivate this type of land are mainly tenant farmers; some of them have been cultivating the same piece of land year after year by mutual or verbal agreement with the owners.

The rent agreed upon varies from year to year. The arrangement for paying the rent is normally fixed by the owner; part of it may be paid before occupying the land and the balance is paid in a lump sum or in instalments as the tenant gets his produce from the land and sells it. Breach of payment very seldom happens, and for this reason the owner prefers the same tenant to cultivate the land rather than give it to new individuals.

Considerable areas of inland padi land are also used for other off-season cultivation. During the last few years quite a number of farmers have tried the sandy *bris* soil for a variety of off-season cultivation and, with the help of farmyard manure and inorganic fertilizer, the returns have been encouraging.

Choice of Crops and System of Cropping

The choice of crops to suit the area plays an important part. Not all the areas have the same degree of fertility—the soil may be anything from coarse sand to fine silty loam. The varieties of cash crops which are commonly planted are water-melon, groundnut and maize. (Plates I, II). Vegetables are sited close to the river for the purpose of ease of watering. Water-melon is normally planted on the coarse to fine sandy areas mostly as a pure stand; groundnut and maize, either singly or intercropped, are generally found on the more fertile land. Sometimes a few beds of vegetables are also planted and any surplus over the farmers' home consumption is brought to the local market for sale.

On the more fertile soil, either another crop of maize/groundnut is planted when the first crop is harvested or the area is cultivated for *padi menghulu* (short term padi). Where dry padi is planted, it is the common practice to intercrop with *jagong padi* (short term maize) or *kachang chatak* (dwarf cow-pea). Wet padi is sometimes planted but the method of planting is different from the usual technique. After the land is cultivated and brought to a fine tilth, padi seedlings which have been sown in a corner of the holding, are transplanted in the dry field in holes made with sticks. This operation is known locally as "*asak*" (dibble) and is generally practised with normal wet padi planting in the event of shortage of water on the field. The last harvest of the year with either foodcrops or padi takes place in early December. If the monsoon rains are abnormally heavy, the river water will rise and flood the area. Some of the vegetable foodcrops may be totally lost as a result and if padi has been grown it is harvested by boats, provided the flooding is not too severe.

Cultivation

Cultivation is mainly carried out by oxen, though recently Rural and Industrial Development Authority (RIDA) tractors are being hired to do the job. Tractor ploughing costs $8.50 per hour. Normally two ploughings and two harrowing are carried out before a fine tilth is

PLATE III

View of off-season cultivation from Guillemard Bridge.

PLATE IV

Cultivation for off-season crops. Note danger of soil erosion if cultivation is near steep banks of the river.

PLATE V

A Pitcher Spout Pump on loan from the Department of Agriculture to an off-season vegetable farmer at Pasir Tumboh.

PLATE VI

Che' Hussein Isa (J.A.A. Sp. Grade) giving a talk to off-season vegetable cultivators on pest control.

obtained. In almost all areas the farmers pay particular attention to land preparation, which is very thorough. (Plates III, IV).

Sowing

Seeds of chillies, brinjals, lobak and tobacco are normally sown on specially prepared seed beds which are raised, fenced and sheltered. When the seedlings are 15 to 20 days old, they are transferred to a specially made circular soil block (*kerek*)—about 2½ to 3 inches in diameter—held together by a piece of coconut *pinna*. The object of this transplant is to harden off the seedlings and at the same time only healthy and robust ones are selected. The method of using *kerek* is confined to the east coast States of Malaya. In the case of water melon, the seeds are sown direct into the *kerek*. When the seedlings have been two to three weeks in the *kerek*, they are then planted in the field and the coconut *pinna* binding the soil is taken off. Maize and groundnut are planted direct in the field.

Preparation of soil blocks, transplanting of seedlings into the block and the care of seedlings from the time they are sown and planted in the field is generally the responsibility of the womenfolk.

Manuring

On the more fertile soil, little manure is used. For water melon and tobacco, however, a large quantity of local organic manure, such as cattle, poultry, goat and sheep dung, and *baja bakar* (refuse ash) is used. Night soil and urine are never utilised as manure even by Chinese cultivators who form about three to five per cent of the farmers. Inorganic fertilizers are used by a small section of the farmers at present and it appears that their popularity is gaining ground.

Weeding

Particular attention is always paid to weeding. This is done by a *changkol* (hoe) or *keri* (a small sickle-like weeding tool) which is commonly used for weeding dry padi fields. As cultivation has always been very thoroughly carried out before planting, weed growth is negligible. The standard of maintenance and absence of weeds is therefore comparable to that found on the west coast amongst Chinese vegetable growers.

Watering

Water is one of the limiting factors to crop production. Since this off-season cultivation is practised during the dry period of the year, (March to August), the position is more serious when a spell of two to four or five weeks with no rain sets in. Where cultivation is sited on the islands and along the river banks, an enormous amount of time and energy is expended on digging small wells and carrying water from them or the river. Practically all the watering is done by direct application to the plants. The use of padi land for off season cultivation is therefore restricted by the difficulty of obtaining water, and in an ab-

normally dry off season period, as this year (1958), practically all the wells in the *kampongs* (villages) and padi fields dry out.

As an experiment, the Department purchased a small "Pitcher Spout Pump" and lent it to one of the progressive vegetable growers, in 1957, as a trial. The pump was fixed firmly on the well and was very light to operate. With a system of furrow irrigation, it was found that with some five hours leisurely pumping under a simple shelter, it was sufficient to saturate a plot of 1/5—1/4 acre thoroughly enough to last for up to three days. With a normal rainfall during the off season, it was found that this pump was invaluable to ensure good growth of vegetables and lessen the amount of hand watering. (Plate V).

Pests

As the islands and river banks are flooded several times for a period of three to seven days during the north-east monsoon, the presence of the common pests of vegetables and other foodcrops is negligible. When outbreaks do occur they are controlled by the use of modern insecticides, as demonstrated by members of the Department of Agriculture on their routine visits to these areas. (Plate VI). The use of these insecticides is on the increase; sales during 1956 and 1957 are shown below.

Year	Double Strength Gammexane Powder (one lb. tin)	D.D.T. 25% (one pint tin)	Agrocide Powder (1.3 lb. tin)
1956	620	7	15
1957	1,309	308	99

Harvesting and Yields

Groundnut, maize and water melon are usually brought to the nearest market for sale either direct to the public or to middlemen. At times, middlemen send out their agents to contact the farmers and purchase the produce in the field. Where the areas are within a radius of up to five miles from a big town, such as Kota Bharu and Pasir Mas, vegetable products and young maize (boiled in the cob) can be seen being brought to the market daily in trishaws and handcarts. Normally, marketing of this produce is done by the wives of the farmers, who purchase other necessities for home consumption after completing the sale of produce.

Prices realised by the cultivators show wide fluctuations. When supplies of a particular crop are decreasing, prices tend to go up. The following are prices of some produce taken during the peak month of the season:—

Groundnut (unshelled)	....	70—80 cents per *gantang*.
Maize (cobs)	....	$2.50—$2.80 per 100.
Boiled maize	....	$2.50—$5.00 per 100.
Water melon	....	30—50 cents per kati.
Padi	....	50 cents per *gantang*.

It is difficult to assess the yields from so many individual holdings and attempts to compile a true income from a few unit areas met with failure. This can be easily understood as most of the farmers are illiterate and they are suspicious of detailed inquiries about their income. However, the net income per normal year from an acre of this fertile land is thought to be in the region of $400 to $500. This is worked out as below; labour by the farmer is not taken into consideration.

(a)	300 *gantangs* * of groundnut at 70 cents per gtg.	=	$210
(b)	5,000 cobs of maize (interplanted) at $2.50 per 100	=	$125
(c)	Miscellaneous vegetables	=	$ 80
			$415

When the above crops are harvested, padi is then planted and a yield of 300 *gantangs* is usually obtained. At 50 cents per *gantang*, this is worth $150 giving a gross income of $565.

The capital outlay in seed, manure, insecticides, payment of rent and other incidentals is estimated at $150. On the other hand, if the farmer plants water melon, the gross income would be $1,000 to $1,200.

In passing, it may be mentioned that these cultivators are painstaking farmers. Nearly all of them have their own houses with a few fruit trees and some livestock. They have a fairly steady income and lead a contented life. They are keen to increase their income. There are, however, limiting factors which bar them from achieving this end, in that suitable land for further expansion is scarce and there is also a limit to the area which a family can work. One family can plant up only about three acres of land with groundnut or maize and, in the case of water melon, only about half to three-quarters of an acre. The restrictive factor in the latter case is the labour in watering; however, this crop is capable of providing from a three-quarter acre holding a gross income of $750 to $900.

Future Prospects

Increased yields can be obtained by the use of more and better fertilizers, cowdung, wood ash and other local manures are used on a limited scale at present; inorganic fertilizer is being tried by some planters and the results are encouraging.

Better pest control is a known factor which can also increase crop yields; towards this end, members of the Department of Agriculture, Kelantan, pay regular visits during the season to give demonstrations on how to combat pests. Many requests have been made by these planters to show them the methods of pest control and these always receive prompt attention.

At present very little is being done by the planters to provide themselves with better varieties of vegetable and foodcrop planting material. Most of the seeds are raised from the previous crops and only

* 1 Gantang = 1 gal. or 5½ lb.

leafy vegetable seed such as mustard, lettuce and Chinese cabbage is bought from Chinese dealers. Water melon seed is either saved from the previous season crop or the melon is bought for seed early in the season when it is imported from Siam.

Marketing of produce is at present the farmer's individual business. Whatever produce he has for sale must be brought to the market himself unless arrangement with a middleman has already been made. This is not only a waste of his time but he must pay for the services of the middleman. If the farmers could combine themselves into a co-operative organisation with good leadership, they could not only organise marketing arrangements themselves for their produce but also could buy other necessities such as fertilizer, insecticides, etc., in bulk at a cheaper price.

Summary

The extent of off-season cultivation and the reasons why such cultivation is more extensive in Kelantan than elsewhere is mentioned.

Methods of leasing State land annually on Temporary Occupation Licence and systems of sub-leasing are discussed.

Choice of crops, systems of cropping, and cultivation methods are described.

Future prospects for improvement of yields are suggested.

Acknowledgement

The writer is indebted to Mr. P. G. Coleman, Mr. J. L. B. Hitchcock and brother officers in the Department of Agriculture, Kelantan, for assistance in the compilation of this article.

THE ESTABLISHMENT AND MAINTENANCE OF FRUIT TREES

BY

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Introduction

Fruit trees are usually obtained in bamboo baskets ready for planting. Other containers, such as wood veneer tubes (1), may be used or plants may be transplanted direct from the nursery to the field, but these practices are not widespread and the latter is not as a rule advisable in the case of most fruit trees in Malaya.

Site

Selection of the planting site is the most important single factor to be considered in the establishment of fruit trees. The commercial fruit grower's requirements are considerable, for he has to consider access for mechanical equipment, proximity to markets and/or means of communication, and availability of suitable labour. All growers, however, have to consider the topography, soil type, drainage and availability of water. Ideally, flat or gently sloping land is best combined with a deep, well drained, medium to heavy loam soil. A reliable source of water should be available nearby for irrigation and/or spraying. Provided these requirements are met, establishment and maintenance of fruit trees and, eventually, production of high fruit yields should be considerably simplified.

Season

It is best to plant out early in the rainy season. Moist but not wet soil and showery weather are desirable. It is important to ensure a long growing period after planting, as dry weather before the plant has developed a sufficiently large root system is most harmful.

Preparation of Site

The technique varies according to the size of the orchard and the equipment available, but consists basically of deep and extensive cultivation and heavy organic manuring.

On a large area of cleared land, mechanical equipment can be used with advantage. The field should first be subsoiled, cattle or other animal manure should then be spread at a minimum rate of 20 tons per acre and this should be ploughed in. Harrowing completes cultivation.

On a small scale, similar operations are carried out using hand tools, but as extensive deep cultivation is difficult when a changkol is

used, it is necessary to pay greater attention to the preparation of planting holes.

Marking Out

This is an important operation. Accurate planting makes subsequent operations easier and provides greater uniformity of growth.

Spacing varies with the type of fruit tree to be used. To provide an increased cash return during the early life of an orchard, filler trees can be planted in intermediate positions between the more widely spaced permanent trees. The positions of filler trees will vary with the arrangement envisaged for the permanent trees, as shown in Fig. I.

FIG. I

Positioning of Filler Trees.

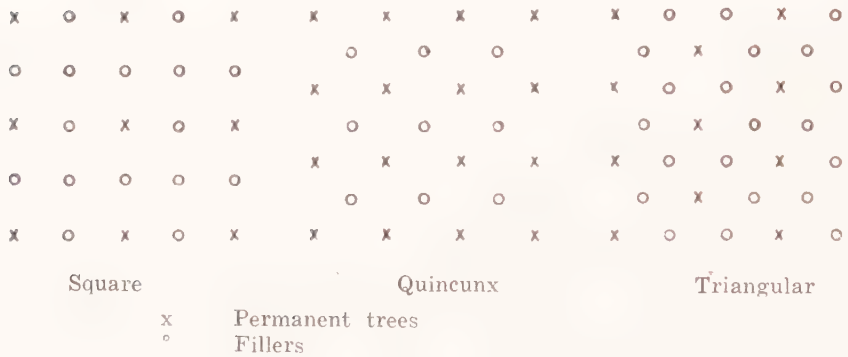


FIG. II

Thinning of Filler Trees.

The most popular and easily managed planting arrangement is the square design. This permits easy and gradual thinning of the filler trees (Fig. II). It is important to ensure that thinning of filler trees is started as soon as crowding becomes apparent. The temptation to keep the trees for another season should then be firmly disregarded.

When marking out, provision should be made for headlands. Corner posts are put in at the extremities of the largest rectangle it is possible to fit to the field. Planting points are then carefully marked on

the boundaries with stakes. Points inside the rectangle are more easily marked as minor errors can be corrected by checking the lining visually. Odd corners outside the rectangle are marked similarly.

Holing and Manuring

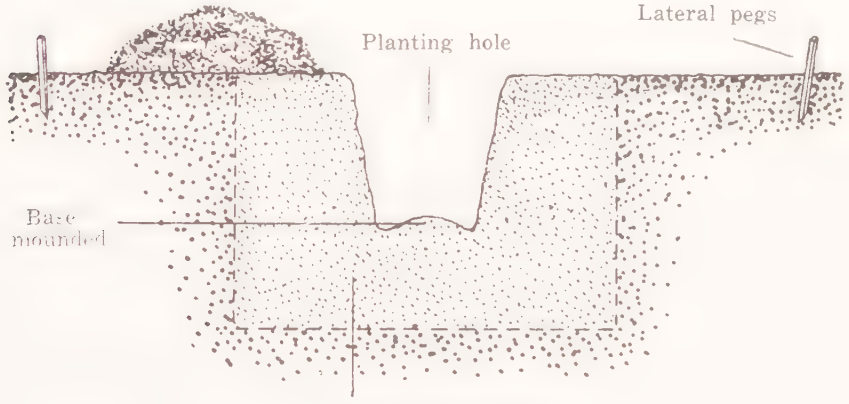
A long planting board, as illustrated in Fig. III, is a first essential.

FIG. III

Planting Board.

The board should be placed on the ground with the central notch fitting into the peg that marks the position of the first tree in the row. A stake is driven in at both ends of the board at sites indicated by the end notches. The board is then removed and the operation repeated at the next and subsequent planting sites, taking care to set the board down with the central notch always facing the same compass direction. Care must be taken in all subsequent operations to avoid disturbing the stakes which mark the position of the planting board.

FIG. IV



If proper mechanical cultivation has been possible and the soil is in good heart and liberally manured, no holing will be necessary until planting is actually carried out. Where preparation by hand is envisaged, this is reduced to a minimum by paying more attention to holing and manuring before planting. In this case, a hole, about 3 ft. square and 18 in. deep, is dug taking care to keep the top soil, *i.e.* the top 9 in., separate from the rest. The bottom of the hole is forked over and some

well rotted cattle or other animal manure worked in. More of this manure and rock phosphate are mixed with subsoil and topsoil as these are replaced in the hole, taking great care to keep the topsoil on top. Where feasible, it is best to use topsoil only for filling the hole. It is usual to incorporate a minimum of 50 lb. of cattle manure and 8 oz. of rock phosphate in one hole. The stake indicating the planting point is replaced in its original position by refitting the planting board between the lateral pegs, and the prepared planting point is left mounded up for two to three weeks to allow the disturbed soil to settle.

Preparation for Planting

Before commencing planting, it is important that atap fronds should be collected and taken to the field for use as shade. Basketted plants which are to be used should have been properly hardened in the nursery before planting, and a few hours prior to their being taken to the field they should be thoroughly watered. It is important to ensure that consignments of plants taken to the field are not too large, in order to avoid undue drying out as a result of exposure to the sun.

Planting

The notched planting board is placed against the marking stake, with the central notch facing a specific compass direction, and lateral pegs inserted. Board and stake are then removed. The soil is consolidated by treading and a hole, about 15 in. square and the depth of a plant basket, is dug. The base of the hole is left slightly mounded.

Normally, the basket can be placed in the planting hole and it will subsequently rot away in the ground. However, where closely-woven baskets have been treated with a copper preservative they may fail to rot away in the soil, thus impeding root growth. If such is likely to be the case, the basket should be removed before planting.

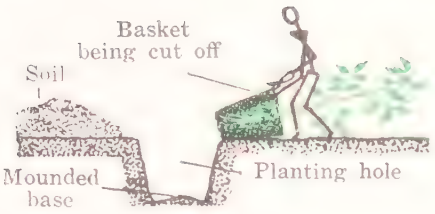
It is advisable to provide a surface mulch of well rotted grass clippings or other similar material to prevent drying out. The plant is pruned as soon as these operations are completed. Side shoots, if present, should be removed and the top cut back to remove the soft, young foliage. It is advisable to cut back to just above a good lateral bud in the axil of a hardened leaf, on the side of the rootstock if budded plants are used.

Staking and Tying

Trees should be tied to stakes immediately after planting as it is then that the tree needs most support. A vertical stake is usually advisable at this stage, but when the tree is older it is preferable to replace this with a heavier stake driven in at an angle with its head into the prevailing wind. When a vertical stake is used, care should be taken not to damage the roots; for this reason it is often the practice to drive in the stake before planting the tree.

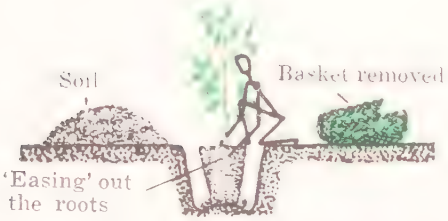
Fig. V

Planting the Tree



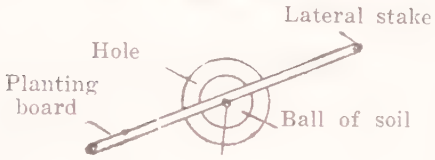
Stage 1

The basketted plant is laid on its side. the basket cut away with secateurs and the bottom of the soil ball is broken a little to expose a few roots.



Stage 2

The plant is gently lifted from the basket and placed erect in the hole, the few basal roots being spread over the mound.



Positioning plant

Stage 3

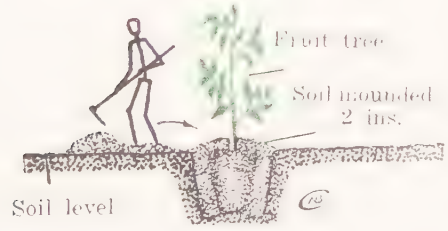
The planting board is put into place and the collar of the plant placed in the notch. The surface of the soil ball should now be level with the soil surface. If it is not it should be corrected.

Stage 4

Soil is shovelled into the hole until it is three quarters full and then consolidated.

Stage 5

Filling is completed, ensuring the plant collar rests in the notch of the planting board, and the soil again firmly trodden down.



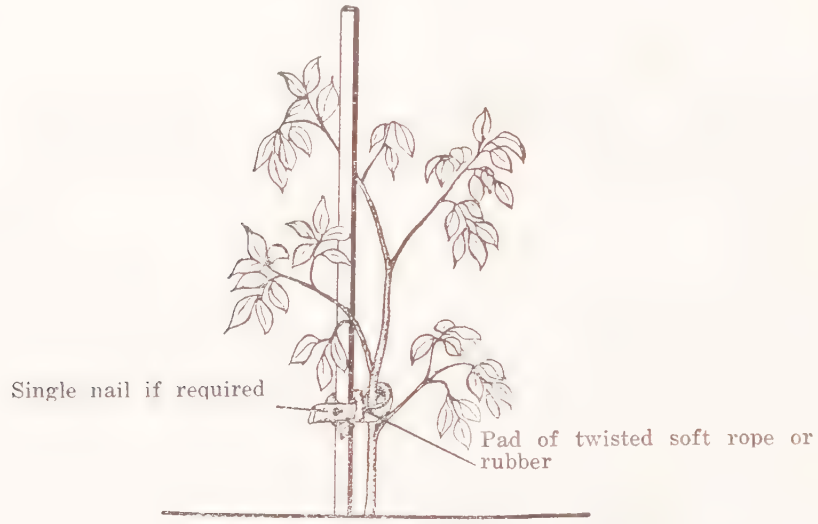
Stage 6

The planting board and pegs are then removed and the surplus soil mounded around the plant to a height of not more than 2 in.

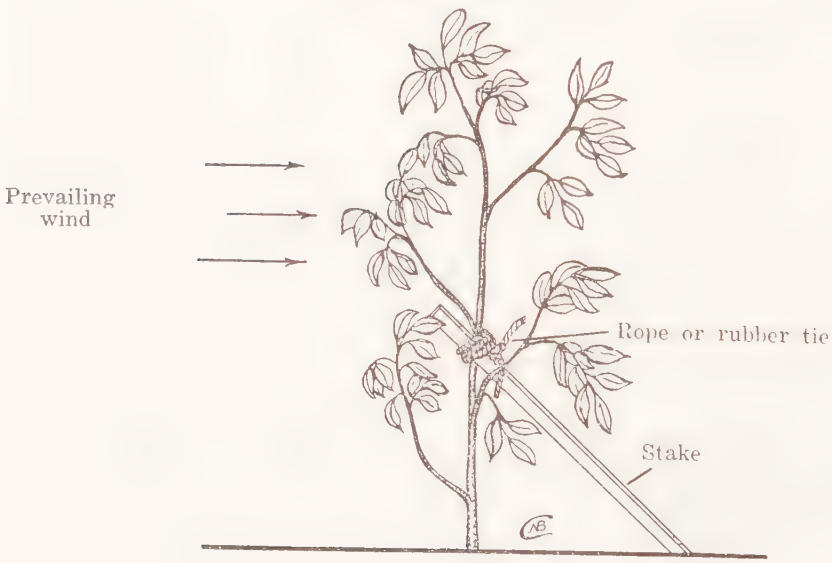
The young tree should be attached to the stake by the use of some soft material such as a strip of sacking or other cloth, old bicycle inner tubes, strips of discarded tyres, or a length of soft rope made from coir (*tali sabut*) or sugar palm fibre (*tali ijok*). This material is looped round the tree stem and then twisted once or twice to form a soft pad between tree and stake and then tied firmly round the stake. Where strips of tyres or rubber are used these can be fixed to the stake with a single nail. This type of tie can be described as a twisted figure 8 (Fig. VI).

FIG. VI

Staking Young Trees.



Staking Older Trees.



Protection

If there is a danger of damage being caused to the trees by cattle, goats, etc., then a strong mesh fence topped with a strand of barbed wire should be erected around the field. Alternatively, trees can be protected individually by encasing them in cylindrical galvanized wire 'tree guards' of 1½ in. mesh wire netting. Trees so protected are more conveniently supported by an upright stake.

Shading

The newly planted and pruned plant should be shaded from the sun for the first week. Holes are made about 9 in. apart on the circumference of a circle of 2 to 2½ ft. diameter around the plant and the bases of atap fronds pushed into the holes and 'heeled' in. Leaflets on the fronds are tied to provide a neat, closed funnel encasing the plant.

Labelling

It is most important, either while planting or soon after, to remove labels and stakes which may be attached to the plant in order to avoid constriction of the developing trunk. Where necessary, staked labels should replace those removed and a plan should be drawn showing the position of varieties or clones for future reference.

Watering

If planting has been carried out at the correct time, this is seldom necessary. If, however, the weather does become dry, regular watering is advisable until the plants are growing strongly, when it may be gradually reduced.

Cover Cropping

There is no doubt that clean cultivation of orchards in Malaya is, in the long run, detrimental, both soil structure and tree yield being adversely affected. Leguminous cover crops are desirable but not always practicable. On a small holding or in a garden, *Calopogonium mucunoides* and *Centrosema pubescens* can be established from seed or *Indigofera endecaphylla* from cuttings. The commercial grower, however, needs a firm, hard-wearing cover for his machines. Carpet grass, *Axonopus affinis*, is ideal for this purpose. This grass cover can be achieved by careful management of the initial weed cover or it can be assisted by spreading shredded turf; in both cases heavy nitrogenous and potash manuring are necessary in the early stages and regular close mowing rounds subsequently.

In the early life of the orchard, the area of a 3 ft. diameter circle around the plant should be kept clean weeded and preferably mulched.

Pruning

It is most important that formative pruning should be carried out in the first few years of the plant's life as this influences future manage-

ment and yield of the orchard. Pruning is then intended to bring about a prescribed shape and form to the tree; thus, for example, a natural head is desirable for durian while an open centre undoubtedly benefits rambutan. Branching can be induced or prevented at will, and this technique—referred to as bud notching—forms an important part of formative pruning. Notching above a desirable bud assists growth of that bud, while notching below an undesirable bud reduces the likelihood of its breaking.

Manuring

This varies with soil, situation, etc.; however the following approximations may be of value. Lime may be necessary and should be applied according to the advice of an Agricultural Officer. Magnesium limestone is a convenient form for use under Malayan conditions. Cattle manure is a desirable additive, particularly during the early years and should be applied four or five times at intervals of 12 months starting a year after planting. The use of fertilizers is to be recommended under most soil conditions. R.R.I. * mixture C 2 is suitable for early growth on all but very sandy soils, but when the trees have matured sufficiently to bear fruit R.R.I. mixture Y is frequently more desirable. The following rates of application intended for plants at 15 ft. spacing on poor soils may serve as a guide.

6 months old	....	¼ lb. per tree per annum
1 to 2 years old	....	1 lb. ,, ,, ,, ,,
2 to 3 years old	....	2 lb. ,, ,, ,, ,,
3 to 4 years old	....	3 lb. ,, ,, ,, ,,
4 to 5 yaers old	....	4 lb. ,, ,, ,, ,,
5 to 6 years old	....	6 lb. ,, ,, ,, ,,

Inorganic supplements can be conveniently applied in two instalments a year, each at the beginning of a rainy period. It is important to appreciate that fertilizer application should be made away from the trunk for best utilization. It should be broadcast on the soil in a ring around the young tree extending from a point a little way within the canopy to a distance of up to 2¼ times the radius of the canopy measured from the trunk. When however the areas of application of adjacent trees overlap noticeably, fertilizer should be broadcast uniformly over the orchard.

Fertilizer may be applied in increasing dosage as the trees develop and mature trees can receive one ton or more of fertilizer per acre according to the financial returns. It is advisable wherever possible for to seek the advice of an Agricultural Officer, who will be able to amend these suggestions to suit specific conditions.

Reference

(1) Allen, E. F. and Whitehead, C.: "The Use of Veneer Tubes for Raising Cacao Seedlings"—*Malay. agri. J.* **38**, 92.

* R.R.I. = Rubber Research Institute of Malaya.

MASTER FARMERS OF MALAYA, VIII.
OMAR BIN MOHAMAD

BY

ARIFFIN BIN MOHD. ZAIN,

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Introduction

The coast of Kelantan is one of sedimentation and accumulation brought on by the influence of tides and winds, which discourage scour and accentuate stagnation at the mouth of the Kelantan and other rivers where the dominant process is the transfer of sediments coastwise (1). Over the years this has given rise to successive raised ridges or *gongs* forming a belt extending some four to five miles inland. These *gongs* consist of very poor sandy soil known locally as *beris*.

This coastal fringe of *beris* is very infertile; the natural vegetation consists of *kemunting* (*Rhodomyrtus* spp.), *gelam* (*Melaleuca* spp.) and *tembusu* (*Fagraea* spp.). It is in this belt that the fishermen of Kelantan make their homes, some planting coconuts on the higher land and cultivating padi in the low-lying areas in addition to their main occupation of fishing. Because of the inherent infertility of the soil, the yields of crops are small and the fishermen have to depend on the uncertain harvest from the sea for their livelihood.

Much has been suggested and proposed for improving the fisherman's lot, among which is the increase of the agricultural produce from this infertile belt. But after all has been said, it is invariably the fisherman himself who holds the key to his salvation.

The following account concerns a farmer, Che Omar bin Mohamad, of Kampong Aur in the Bachok district of Kelantan, a *kampong* (village) right on the beach, who has proved that it is possible to make a fairly reasonable living even on the infertile *beris* belt.

Che Omar has never been a fisherman. He started his life as a small trader but in 1954, when he was about 40 years old, he gave up trading and decided to "go back to the land". With the capital he had amassed he bought himself 33 acres of established but almost barren coconuts and three acres of padi land. Of the 33 acres of his land, seven acres of coconut holding on which his house is located are close to the sea and three acres of padi are within a few minutes walk from the sea. The remaining 23 acres of poor-yielding coconuts are scattered within a radius of five miles from his house, and most of the remaining areas are outside the coastal belt.

Che Omar, who is assisted by his wife and nephew, realized from the start the value of organic manure in rehabilitating his seven acres of coconuts. Therefore within the seven acres, he introduced for a start 60 Cantonese and locally selected hens, together with a few R.I.R.

cockerels. At the same time he purchased four female buffaloes and two female goats. All animals and poultry are satisfactorily housed at night, and the manure produced is applied to the coconuts.

As a result, the yield of fresh nuts from these seven acres has increased over the past four years from 1,500 to 4,500 nuts per year. Although the yield is still very low, there is undoubtedly a great improvement which will continue under the present management. Che Omar has also put down a one acre coconut manurial demonstration plot using locally available fish refuse which is mixed with clay or peat soil and crushed sea shells and applied to the trees.

From the remaining 23 acres of coconuts he obtains 19,100 nuts per year. This yield is comparatively higher than the seven acres previously mentioned because the majority of the land lies outside the coastal fringe where the soil is much more fertile or where there is closer settlement. Of his total production of 23,600 nuts per year, 7,200 nuts are fed to the poultry, 400 are kept for home consumption and the remaining 16,000 are made into copra by sun drying and sold at $20 per *picul*. It is estimated that some 53 *piculs* are produced at 300 nuts to the *picul*.

Che Omar has within the past four years increased his flock of poultry to 600 birds, his goats to 28 and his buffaloes to eight head.

His wife and nephew look after the poultry. They make sure that the young pullets and cockerels are inoculated against ranikhet disease at six weeks old. Also all unwanted cockerels are caponized. From about 400 laying hens of the local *kampong* type, he obtains about 100 eggs a day which he sells at 11 ct. each in the nearby market. In October, 1957, he sold 450 fowls, (mostly cockerels and poor condition pullets) weighing seven piculs for $700. He produces all replacement chicks by the use of broody hens.

The poultry are fed on sago, coconut meat and padi, the feed which costs about $7.5 per day for the whole flock, is made up of the following:—

(a)	Sago	$ 3.00
(b)	Coconuts (20 per day)	$ 1.60
(c)	Padi (5 gantangs per day)	$ 2.75
	Total	$ 7.35

Therefore his net income per day from the sale of eggs is $3.65 to which must be added any income derived from the sale of birds for meat.

His buffaloes do not only produce the valuable manure so necessary for his coconuts; four working animals are hired to padi farmers for cultivation work. For this he receives a payment of 400 *gantangs* padi per year at 100 *gantangs* per animal. This padi is paid in lieu of wages to the man who is employed at various times during the year, mainly during the padi season, in looking after his buffaloes. During the padi season the buffaloes are also used to cultivate the land between the

PLATE I

Che Omar's wife feeding the poultry. Note R.R.I. cockerel in middle.

PLATE II

Che Omar with his buffaloes and cattleshed. Straw will be used as a bedding after the padi harvest to provide manure.

PLATE III

Che Omar standing in his manured padi plot.

coconuts. The buffaloes are housed in a cattle shed and padi straw from his padi land, baled by a Departmental baler, is used for bedding.

Fodder for his buffaloes has proved a problem, but this will soon be overcome when Che Omar establishes at least an acre of *Stylosanthes gracilis* under his coconuts in the coming year.

The goats at present are not bringing in any income, as they are not large enough for sale. His wife and nephew look after the goats which are let out on free range during the day and housed in a shed at night.

In the previous three or four padi seasons Che Omar obtained a yield of about 200 *gantangs* per acre from his three acre padi lot of very poor sandy soil. During the 1957-58 season he was persuaded by the staff of the Agricultural Department to apply cattle manure to his padi nursery and *baja padi* (fertilizer) to the land at 200 lb. per acre. As a result the yield per acre was increased to 350 *gantangs*. From the total padi production 400 *gantangs* will be kept for consumption and the remainder will be fed to the poultry.

It is difficult to assess accurately his gross expenditure, but Che Omar's gross annual income is as follows:—

(1)	Sale of copra, 53 *piculs* at $20 per *picul*	1,066.00
(2)	Production of 7,600 fresh coconuts at 10 ct.	760.00
(3)	Sale of fowls for the table (say)	500.00
(4)	Sale of eggs	3,300.00
(5)	Income from the sale of padi derived from the hire of buffaloes (at 55 ct./*gantang*)	200.00
(6)	Home production of padi, 1,050 *gantangs* at 55 ct./*gantang*	577.50
	Total	$6,423.50

Conclusion

It may be said that Che Omar was a relatively wealthy man when he took up his holding on the *beris* in 1954. However, there is no doubt that by hard work and an enlightened outlook he has already increased his wealth, even though his holding is on some of the most infertile soils in Malaya. Che Omar as he is now, stands as a living example to the fishermen in the locality of how to improve their living conditions. On that *beris* type of soil, the answer is coconuts, helped by liberal applications of organic manure. Che Omar has long realized that. With his properly housed livestock and the use of padi straw as their bedding and with the application of animal manure to his coconuts Che Omar has successfully put into practice the principle of mixed farming for stable and productive agriculture.

Reference

(1) Dobby, E.H.G.G.: *"Southeast Asia"*, 1951.

NOTES ON CURRENT INVESTIGATIONS AND EXTENSION WORK

April to June, 1958.

Weather

Drought conditions prevailed generally during April and part of May, and delayed the commencement of cultivation of padi lands in the north; onset of rains in May/June enabled commencement of nursery sowing in the northern regions towards the end of the quarter.

Research

Padi

Nearly all the 1957/58 results of botanical trials have been received and completed experiments have been analysed. On the whole, the season was most successful and yields were in most cases above average. Only a few trials suffered from pests, diseases or adverse climatic conditions.

At Bachok, in Kelantan, a trial of Saigon varieties has been completed over three seasons. The variety Cadung Ket significantly outyielded the control (Siam 29) by over 700 lb. per acre, its mean yield being 3,122 lb. per acre.

In a series of trials, carried out in Kelantan, in which various varieties introduced from Kedah and Province Wellesley were compared, Subang Intan 117 has emerged as the most successful variety with Radin Kelumbong as runner-up. Subang Intan 117 gave an average increase of approximately 10 per cent over unselected Anak Naga used as the control.

In a trial to assess the suitability of new Serendah Kuning selections to the inland districts of Malacca, Serendah Kuning 30, 23 and 21 have significantly outyielded the unselected variety, giving yield increases of 400—500 lb. per acre.

Extension trials using the selected variety Nachin 39 have been carried out in the coastal districts of Malacca. In 37 out of 39 trials Nachin 39 gave higher yields than the local variety. In similar trials with Serendah Kuning 23 laid down in the inland districts of Malaya, that selection outyielded the local varieties at 17 out of 20 sites. It is estimated that the combined use of Nachin 39 in coastal and Serendah Kuning 23 in inland districts of Malacca could give an increase in padi production of 12.75 per cent over the whole State.

Varieties introduced from Italy and Taiwan have been grown for observation in Kuala Lumpur.

The results of 21 field insecticidal spraying experiments to control stem borers show that on all experimental sites borer attack was light. Despite this, an increase in yield of grain was obtained in seven experiments by spraying at intervals of two weeks throughout the growing season. Spraying once, four weeks before flowering, gave a significant

increase in yield in three experiments. Dieldrin was used in 12 of these tests and D.D.T. in the remaining nine.

The uptake of nutrients at various stages of growth in high yielding padi areas at Sekinchang has been investigated and compared with the uptake from lower yielding areas at Sungei Burong and Sawah Sempadan. It has been found that most of the nutrients are taken up in the first ten weeks after transplanting and nearly half the amount of nitrogen and potash found in the plant at harvest and a quarter of the total phosphate are taken up in the first six weeks. Grain yield in high yielding areas appears to be closely related to nitrogen uptake.

Investigations into *penyakit merah* are continuing and pot trials using six soils have begun. Tiller counts at or near flowering showed that on nearly all soils an application of phosphate increased the tiller number. Lime gave the same result unless the pH was raised abnormally high (above pH 7.0) by the lime application (5 tons per acre). The application of manganese has given a significant increase in tiller number in only one soil. The application of potash, mangnesium and zinc has produced no significant effects. The number of orange leaves (a symptom of *penyakit merah*) per tiller showed, on all soils, a significant increase where phosphate was applied and a significant decrease where lime was applied.

Agronomic Investigations and Extension

Results from the new series of extension trials on cultivators' land initiated last season have been received from Kedah, Kelantan, Trengganu, Malacca and Negri Sembilan. The results from Kedah have gone a long way in revealing the main cause of the variation in yield increases from fertilisers encountered in previous seasons.

Results have also been received from experimental stations throughout the country. With the ending of the last padi season, during which experimentation was of necessity on a much reduced scale, more time has become available during the quarter for writing up the large amount of undigested results outstanding from previous seasons. A similarly restricted programme for the coming season has been drawn up, consisting mainly of current experiments designed to continue for a number of seasons, but including a few new trials on the most promising lines suggested by past work, in particular manuring of nurseries.

The off-season at Parit, the site of the mechanisation pilot scheme, is being used to improve water control by building an internal irrigation system fed from a high level distributary and constructing bunds and levelling the fields formed. 20 acres of the target of 50 for this off-season had already been completed by May. A small field of soya beans has been planted for observation as an off-season crop and is growing satisfactorily.

Progress was made towards evolving an 'ideal' buffalo plough incorporating desirable characteristics of both Japanese and local ploughs. The latest prototype incorporates the Japanese hitch method of plough

body construction with straight wooden beam and steel reinforcement, and a mouldboard giving improved inversion, with the centre-point share of the local Malacca plough. The aim is to keep the plough light but strong and cheap to manufacture locally. The latest plough is to be tested against a Japanese one under varying field conditions found throughout the country.

The 1957/58 harvest of wet padi was an all-time record. For the first time, the Federation's production exceeded 300,000,000 gantangs, equivalent to over three-quarters of a million tons of padi or almost half a million tons of milled rice. This level of production is nearly 25 per cent above the post-war average and nearly 50 per cent above the pre-war average, both calculated over 10 year periods.

This record production is due in part to the increased area of land planted with padi last year: 857,460 acres. This area is four per cent above the post-war average and 25 per cent above the pre-war average, although it falls short of the record of 871,470 acres planted in the 1949/50 season. Last season only 7,000 acres of planted wet padi were destroyed by flood, drought, pests or diseases as against an annual average of 24,000 acres. As a result, the area of padi land harvested, 850,200 acres, was only slightly below the record acreage of 1949/50 and was some six per cent in excess of the average for the ten seasons since 1947, when statistics for the area of harvested padi land were first collected.

Higher yields per acre have, however, been the major contributer to increased production. The 1957/58 crop averaged over 358 gantangs per acre over the whole country and slightly exceeded the 1956/57 yield which was itself a record. Yield per acre has continuously risen over the past four years and the 1957/58 figure is now 15 per cent above the post-war average. These yields have been calculated on the acreage of padi land harvested.

Sowing of nurseries for the off-season padi crop in Province Wellesley was undertaken in April/early May. The total area planted was 7,650 acres, comprising 520 acres in Province Wellesley North, 7,000 acres in Central, and 130 acres in South. Plant growth is reported to be good in all areas, with little pest damage. About 400 acres were planted with padi during the off-season in Kedah. Renewed interest in double cropping has been reported from Kelantan, and arrangements were made for a party of cultivators from the Salor irrigation area to visit Province Wellesley to study growing methods in that region.

Distribution of seed padi of selected varieties was undertaken from Padi Stations throughout the country during the quarter. The total quantity distributed to padi planters by sale or exchange amounted to 14,350 gantangs. In Malacca, where yield increases of the order of 50 to 80 gantangs per acre have been obtained through the use of seed of selected varieties, a total of 5,900 gantangs of selected seed, produced on seed farms under Departmental control, was distributed to padi planters under a padi seed exchange scheme operating in that State.

An aggregate area of 2,300 acres in the districts of Rembau, Tampin and Seremban (coast) in Negri Sembilan produced no crop last season due to very late planting. A campaign has been launched thoughout the State with the object of informing padi-planters of the advantages to be gained by following scheduled planting dates, and 20,000 leaflets with recommendations on suitable planting dates for the 1958/59 season were distributed to padi planters in all districts.

Government-financed padi fertiliser subsidy schemes are in operation in the States of Kelantan, Trengganu, Negri Sembilan and Malacca. In Kelantan, where the scheme is in its seventh year, there is a Government subsidy of 90 cents paid on every 100 lb. bag of padi fertilizer mixture supplied to cultivators by approved agents—the cost to the cultivator being $10.50 per 100 lb. bag, or $21 per acre if the fertilizer dressing is applied at the recommended rate of 200 lb. per acre. In Trengganu, the Government subsidy rate for the current season is $2 per 100 lb. bag, and the cultivator will pay $19 per acre for fertilizer application at the recommended rate. In Negri Sembilan, the actual cost of fertilizers for padi under the subsidy scheme is $30 per acre, including price of bags and delivery charges; the individual cultivator will pay $18.50 per acre, with the balance of $11.50 met from subsidy scheme funds. The subsidised price for padi fertilizers in the Malacca scheme will be $20 per acre in the 1958-59 season; actual cost without subsidy is $26.70.

Padi Planters Boards have previously been established in Kedah, Perlis, and Pahang to formulate and implement schemes for assistance to padi planters, and progress towards the formation of similarly constituted Boards has been reported from the States of Selangor, Perak and Kelantan.

Other extension activities undertaken during the quarter include the organization of padi competitions at mukim, district, and State level in most States; the organization of rat destruction drives, particularly in Perak; distribution of leaflets to encourage the use of ammonium phosphate for nursery manuring in Kelantan, Negri Sembilan and Selangor; preliminary arrangements for laying down an extended programme of nursery management and field manuring demonstrations in all States in the 1958/59 planting season.

The acreage under upland dry padi this year is expected to show a considerable increase in area as compared with last season, particularly in the East Coast States of Kelantan, Trengganu and Pahang, where extensive areas of jungle land have been felled, cleared and burned, and will be catch-cropped with upland dry padi and foodcrops prior to planting with rubber.

Rubber

Distribution of planting materials to rubber smallholders during the quarter for replanting and new planting from nurseries under Departmental control amounted to 40,635 yards of budwood and 1,000,905 clonal seedling stumps.

Oil Palm

An experiment on the control of *Curvularia* seedling blight of oil palms, carried out on a cooperative basis on an estate in Johore, has been completed. Four fungicides, based respectively on TMTD, captan, zineb, and copper oxychloride were compared. Of these, captan gave the best results, treatment with this fungicide resulting in good control of the disease and in improved growth of the seedlings, as judged by the length of the longest frond.

Coconut

Prices for smallholders copra have remained generally steady and ranged between $23 to $27 per picul.

Manurial demonstration plots using organic manures and inorganic fertilizers on '*beris*' soil in Kelantan, Trengganu and Pahang laid down in 1957, continue to interest smallholders in the localities concerned, and an increase in the number of demonstration plots is being undertaken in Pahang in the coastal area between Pekan and Rompin. It is estimated that the acreage of smallholding coconut land in Kelantan and Trengganu which would be particularly responsive to fertiliser application exceeds 21,000 acres.

Coffee

The price at Klang, Selangor, for dried beans of Liberian coffee increased from $155.00 to $158.00 per picul during the quarter, and interest in planting this crop on a small scale has been maintained in Perak, Negri Sembilan and Trengganu.

Cacao

The obscure complex of conditions collectively known as "die-back" was severe during the quarter and investigations into various aspects of the disorder were carried out. The possibility of a parasitic organism being involved is being explored. Fungi have been isolated from affected but still living stems and these are being inoculated on to healthy plants to discover whether they are primary parasites or secondary invaders. Work is also in hand to test the possibility of a virus disease being involved.

Severe defoliation of cacao trees in one field at the Federal Experiment Station, Serdang, was largely caused by the Limacodid *Limacosilla pirifera*, which fed on the older leaves. Control was achieved by spraying with lead arsenate.

Analysis of leaf samples from healthy trees growing on alluvium in South Perak showed that they were lower in nitrogen, phosphorous, potassium, calcium and iron, higher in magnesium and very much higher in manganese than were leaf samples from healthy trees of the same age (4-5 years) growing on a sedentary granite soil in Trengganu.

Owing to the considerable increase in the incidence of die-back on the cacao at Jerangau and to the deterioration in the staffing position in the Agronomy Branch, a Working Party was constituted to develop a research programme. This programme was drawn up and suggested the following lines for investigation:

(i) Possibility of the presence of a pathogene.
(ii) Mechanism of the beneficial effects of soil exposure.
(iii) Use of sand culture technique in studying element deficiencies or toxicities.
(iv) Development of a leaf injection technique.
(v) Leaf analysis.

Commencement of a smallholder pilot scheme extending to 48 acres at Kampong Awah, Pahang, has been deferred, pending further investigation into the die-back which has affected cacao trees in other areas. Die-back has also occurred to some extent in an area planted in 1956 in the smallholder pilot scheme at Jerangau, Trengganu. Action on pruning and application of wound-dressing to pruned branches has been undertaken. Standards of maintenance between holdings, each being four acres in extent, are variable.

Pineapple

A manurial experiment on the effect of adding different amounts of potash to plants from which leaf and fruit samples were taken for analysis has been concluded. It appears from this experiment that a 2 : 1 : 5 (NPK) fertiliser is likely to be the best for Singapore Spanish and Sarawak varieties and that it would be advisable to add about 30 lb. of magnesium limestone for every 1,000 plants every second year. It is also concluded that for good growth the water-table should be not less than 24 to 30 inches below ground level.

While still retaining charge of the Federal Experiment Station at Alor Bukit the Senior Agronomist proceeded with the transfer of station work to the Malayan Pineapple Industry Board's newly appointed assistant technical staff. What experience in experimental technique the Branch has accumulated in the past was made available to these officers.

The peak harvesting period in Johore was reached in May/June, and all canneries were operating at capacity. The overall rejection rate of smallgrowers' fruits remained at a high level, and abandonment of holdings has continued due to the low prevailing price of 2.5 cents per pound for fruits.

In the Kuala Trengganu and Besut districts of Trengganu interest has increased among smallholders in planting pineapples as a catch crop in newly cleared areas. Sarawak pines have fetched prices of 30—50 cents each, and Mauritius 8—10 cents.

Fruit

Leaf mottling, followed in severe cases by the formation of very small leaves and twig die-back, has been observed in several mandarin

orange orchards in Perak, Johore and Malacca. The symptoms suggest a deficiency disease and field observations are being conducted to discover whether the symptoms can be eliminated by foliar spraying.

The Senior Agronomist accompanied by an Agricultural Officer visited Thailand for a week during April to make a quick survey of the citrus industry and in particular to obtain information on the origin, history and culture of the neck orange, Limau Chembol. They found that while the growing of citrus was more extensive than in Malaya, the techniques used were on the whole no different from those found in Malaya. On the few samples of sweet orange fruit available on the market at the time of their visit, they concluded the quality was no better than that of similar material in Malaya. Strangely enough, some of the neck orange trees in South Thailand appear to have originated from material imported from Trengganu. The officers were able to establish a contact for supply of neck orange seed from South Thailand.

A total of 8,853 fruit trees were sold from Departmental Stations during the quarter, and in addition 4,973 plants were distributed by commercial nurseries through the Department. The demand for high-quality fruit trees, particularly from new land development scheme areas, continues to expand, and in several States arrangements are being made to encourage the expansion and/or establishment of commercial fruit nurseries using clonal material from Departmental sources. In Trengganu, mandarin orange planting material is in big demand, and the Department has encouraged reliable growers to produce marcots for sale/distribution.

Light crops of durian, rambutan and other seasonal fruits were harvested towards the end of the quarter in the west coast region generally. The durian season in Johor,e which commenced about the middle of June, was relatively good, and fruits which fetched a price of $25 per picul wholesale for the producer, retailed at over 60 cents a kati in Singapore. Prolonged drought conditions earlier in the season were responsible for the relatively poor fruit harvests in other regions.

Pruning demonstrations, carried out on rambutan trees after the last fruit harvest in December/January, on the holdings of Progressive Farmers in Kelantan, have aroused local interest. Flowering of old and young trees has been profuse and earlier than unpruned trees, and more widespread adoption of this practice annually after fruit harvest can be anticipated in future in the kampong areas where demonstrations have been carried out.

Water melon is a crop which has gained in popularity in several localities. In East Pahang, the Department has laid down 16 demonstration plots, with the object of encouraging the cultivation of this crop among padi planters and fishermen as a supplementary source of income. Fruits have fetched $10—$15 per picul, depending on quality.

Tea

It has been reported previously that a combined nitrogen

phosphate fertiliser dressing had given a profitable return on highland tea. Latest results from an observation on nitrogen fertiliser on tea at Cameron Highlands have further indicated that, given a basal dressing of a phosphatic fertiliser, the application of nitrogenous fertiliser can be increased considerably while still maintaining the same very profitable return per unit of fertiliser, viz., $200 made tea for $18 fertiliser.

Tobacco

There has been increasing interest in the cultivation of this crop in North Pahang, particularly in Jerantut district. Planting is done mostly on new clearings of land intended for rubber. Prices for cured leaf were $120—$150 per picul for Grade I, $80—$120 per picul for Grade II, and $40—$80 per picul for Grade III.

In Perak, the mid-year crop acreage planted was about 1,300 acres, and harvesting was in full swing at the end of June. Prices up to $240 per picul were paid for cured leaf of best quality.

Livestock

Pigs

In Malacca, 80 per cent of the pigs slaughtered at the local abbatoir are Middle White cross-breds. In order to multiply local stock which is free from Middle White blood, for breeding purposes in the future, the Department in Malacca maintains a breeding herd of Sitiawan Black pigs. Stock from this herd is in strong demand by local pig breeders and three boars and seven gilts were distributed during the quarter. The demand for pure Chinese breed pigs for crossing is on the increase in many States, and in Negri Sembilan for example, the Department has established a breeding herd of pure local stock, to meet future demands for breeding gilts of this type.

Departmental sales of Middle White stock totalled 89 boars and 46 gilts during the quarter. In addition, 568 services were recorded at new village stud centres and 41 at Departmental stud centres and 41 at Departmental stud farms.

Poultry

Commercial poultry rearers in Johore and Penang have complained about the large-scale importation of low priced eggs into the Federation from China via Singapore and Thailand respectively, stating that such importations lower the price of locally produced eggs to below economic levels. In Penang, the price of kampong eggs was 7—8 cents each in June as compared with 10—12 cents at the beginning of the year.

Sales for breeding purposes from Departmental Stations totalled 75 cockerels, 95 pullets, and 326 hatching eggs during the quarter. In addition, 29,170 eggs have been sold for consumption.

Cattle

In Kelantan and Trengganu the programme initiated by the Department to encourage stall-feeding of cattle is proving very success-

ful. Financial aid was granted to progressive farmers to assist in the construction of cattle sheds, on condition that the farmer undertook to establish a reasonable area of the fodder Stylo. The value of this drought-resistant fodder has been well demonstrated in Kelantan during a recent three month drought period, and demands for planting material, to be established without departmental aid, are considerable. In Kelantan also, the erection of cattle sheds has continued to increase spontaneously and it is reported that there are now 152 cattlesheds in Bachok district alone, following the example of the initial four sheds constructed in the locality with departmental assistance.

Vegetables and Food Crops

About 650 acres of off-season maize has been planted in the Trans-Perak River Irrigation Area; this is an encouraging response resulting from a visit to the Chui Chak area arranged previously by the Department for a group of cultivators from Trans-Perak. Off-season cropping on the normal extensive scale was undertaken by padi cultivators at Chui Chak in Perak, Sekinchang in Selangor, on Penang Island and in Malacca Central.

It is reported that vegetable production in the Cameron Highlands decreased considerably during the quarter due to excessive rainfall in April/May, and in consequence, prices increased. The use of new chemical insecticides is on the increase among vegetable growers in the Cameron Highlands area.

Pasture and Fodder

A new trial designed to compare six imported strains of African Guinea Grass with the local strain and to try out a new planting pattern thought to make mechanical harvesting possible, has been successfully established at Serdang. The first experimental harvest has been recorded and samples taken of the cut grass for chemical analysis.

Mushrooms

An interesting note is included in the report of the Senior Agronomist's visit to Thailand, on the technique used by the University of Thailand to produce pure spawn culture of the Chinese mushroom, *Volvaria esculenta*. The spawn is distributed to farmers who grow the mushrooms during the off-season, on padi straw. The mushrooms find an easy market, their culture is profitable and the field technique is not difficult to master.

Soil Survey

In the padi soils survey of the Kedah coastal plain, the total area covered during the season was approximately 65,000 acres. The mapping was carried out mainly by straight line traversing at close spacing. The accuracy obtained was probably of the same order as obtained by

actually following out the boundaries on the ground as was done last season, though in places some further checking of boundaries may be necessary.

Good progress has been made in the soil survey of the upland areas of Kedah. A number of development areas has been examined in detail, e.g., 2,400 acres in the Sungei Tiang area and 4,000 acres at Bukit Tembaga. In addition, two extensive areas, one of 30,000 acres at Telui Kanan and another of 20,000 acres in the Sungei Laka area, have been examined by reconnaissance survey methods along *rentis* lines spaced at intervals of about one mile.

A beginning has been made on the soil survey of some 10,000 acres of land in the Labu Forest Reserve in Negri Sembilan. Preliminary traverses have been made through an area of about 5,000 acres on the Maran-Temerloh road in Pahang and *rentis* cutting is now progressing in an area of 13,000 acres in the Sungei Bilut valley.

Pests and Diseases

Among the new pests and diseases recorded during the quarter were the following:

Corticium solani (previously found on other hosts) occurred on *Stylosanthes gracilis* and the grasses *Bothraochloa insculpta, Melinis minutiflora* and *Panicum maximum,* causing leaf rotting and blotching.

Gibberella sp. caused a die-back of rambutan branches.

Larvae of the Noctuid moth *Rivula innotabilis* and the Tortricid moth *Eboda celligera* were found feeding on padi leaves.

The Eumolpid beetle *Demotina serraticollis* was recorded on rambutan, feeding on the fruit.

Education

Newsletters

10,000 copies of the Kelantan agricultural newsletter, *Berita Tanaman,* were distributed to smallholders in the State. Issues of newsletters in Penang (Malay and Chinese versions) and Trengganu were prepared and forwarded for printing during the quarter.

Training Centres

Courses were held at Rural Agricultural Training Centres in all States, except Perak, during the quarter. Over 400 persons attended these courses.

Departmental staff continued to give lectures and demonstrations on agriculture to members of the public attending Civics Courses in Kedah, Penang, Perak, Negri Sembilan, and Malacca. "Students" ranged from Indian and English school teachers, Chinese school pupils, trainees from the Federal Customs Training Centre, to kampong Malays and aborigines.

To date, four kampong Agricultural Committees have been formed

in Kelantan. These are committees of progressive farmers who set out to encourage other farmers in the locality to improve their holdings and thus improve their standard of living. At Bachok Agricultural Station a hostel is being erected by smallholders as a result of a proposal by the Telong Agricultural Committee, so that interested farmers may attend instructional courses at the Station.

It is reported from Perlis that the initial response to the community development scheme started in the State has been encouraging. There has been an increased demand from smallholders for vegetable seeds, advice on pruning, manuring and control of pests on fruit trees, and also for Stylo for establishing cattle fodder areas.

Development Schemes

The Besut Land Development Board in Trengganu has appointed administrative staff for the scheme at Chalok, and work commenced on felling, burning and clearing on area of 160 acres for housing sites. The schemes will cater for 400 families; the area being 4,000 acres in total. The manager is a Junior Agricultural Assistant on secondment from the Department. Work has commenced on preparing a four acre block of land for establishing a rubber budwood nursery.

62,000 clonal rubber seedling stumps were distributed to settlers in various development scheme areas in Kedah during the quarter. In addition, 29,000 clonal stumps were distributed to ex-S.C. settlement areas at Cherok Makan, Kuala Muda and Kulim.

In the Sungei Lui and Mah San land development scheme areas in Negri Sembilan, contract clearing of the land commenced at the end of June. The Sungei Lui scheme will extend to approximately 1,140 acres and accommodate 125 families; the Mah San scheme is for 69 families and will extend to 552 acres. In both schemes, planting of rubber is scheduled to commence in September this year.

An Agricultural Assistant has been seconded for service as manager of schemes under the Jasin District Land Development Corporation, in Malacca. Contract felling and clearing of 390 acres of land was completed during the quarter in the Nyalas Road Development scheme, and establishment of a one and a half acre rubber budwood nursery was undertaken at the Kemendore land development scheme area.

STAFF NOTES

(Period 1st July—30th September, 1958)

Obituary

It is with the deepest regret that we record the death of Mr. Yoh Toh Kia, Cadet Agricultural Assistant, Research Branch, aged 26, at the General Hospital, Kuala Lumpur, on 21st September, 1958.

Mr. Yoh was born in Batu Pahat, and was educated at the Government English School. He graduated from the College of Agriculture, Serdang, in 1957 and had since been engaged on soil survey duties in the Soil Science Division. In spite of the occasional severe pain caused by his complaint, Mr. Yoh continued to carry out his often arduous field work, and only reluctantly agreed to withdraw from a forthcoming jungle soils reconnaissance a few days before his death.

Mr. Yoh was a very capable officer who quickly acquired the necessary skills of his appointment. He was untiring and conscientious in his duties and possessed infinite patience. Quiet and unassuming in his manner, Mr. Yoh was an extremely cheerful and good humoured colleague. His passing is deeply regretted by a wide circle of friends throughout the Department.

To his mother we extend our deepest sympathy and sincere condolences on the death of her eldest son.

Honours and Awards

Che Kamardin bin Bakar, Assistant Research Officer, Headquarters, was awarded the decoration of Ahli Mangku Negara by H.M. the Yang di-Pertuan Agong, on the occasion of the First Anniversary of Merdeka, 1958.

Che Abdul Jalil bin Noordin, Agricultural Assistant, Kelantan, seconded as Manager, Tanah Merah Land Development Scheme, Ayer Lanas, Kelantan, was awarded the decoration of Ahli Kelantan; Haji Hassan bin Hj. Abdullah, Junior Agricultural Assistant, Special Grade, Kelantan, was awarded the Pingat Bakti; and Che Alias bin Ngah, Mandore Grade I, Kelantan, was awarded the Pingat Ta'at, by H.H. the Sultan of Kelantan on the occasion of His Highness's birthday in August, 1958.

Che Hashim Shah bin Mohd. Shah, Agricultural Assistant, Negri Sembilan, was awarded the Pingat Jasa Kebaktian, by H.H. the Regent

of Negri Sembilan on the occasion of the birthday of His Highness the Yang di-Pertuan Besar, in August, 1958.

Appointments

Name	*Appointment*	*Date*
Mohd. Ridzuan bin Mohd. Nor	Pupil Agricultural Officer, (Posted as Agricultural Officer, Johore Central)	4.9.58
Ahmad bin Yunus	Pupil Entomologist	15.9.58

Postings

The following postings have been made:—

Name	*Posted as*	*Date*
P. Class	State Agricultural Officer, Johore (Acting Senior Agricultural Officer, Grade A)	22.7.58
Mohd. Tamin bin Yeop	State Agricultural Officer, Malacca (Timescale)	25.8.58
Wan Mohamed Don bin Mohamed	Pupil Agricultural Officer, Perak North	1.9.58
G. F. Darnell	State Agricultural Officer, Negri Sembilan (Timescale)	12.9.58
L. A. Vivian	State Agricultural Officer, Kelantan (Acting Senior Agricultural Officer, Grade A)	23.9.58
F. B. Brown	Assistant Director (Research) (Acting)	25.9.58
Van Thean Kee	Senior Botanist (Acting)	25.9.58

Retirements

The following officer proceeded on leave prior to retirement under the Tenth Schedule to the Federation of Malaya Agreement (Amendment No. 4) Ordinance, 1956:—

Name and Rank		*Date*
A. Johnston	Senior Research Officer, Grade A. Acting Assistant Director, (Research)	24.9.58

Leave

The following officers have proceeded on leave:—

Name and Rank		*Date*
J. L. B. Hitchcock	Senior Agricultural Officer, Grade A	22.9.58
S. Selvadurai	Pupil Agricultural Economist, (Study Leave)	22.9.58
R. J. R. Barrett	Agricultural Officer	25.9.58

Notes on Retiring Officers

Mr. A. Johnston left Kuala Lumpur on leave prior to retirement under the Tenth Schedule to the Federation of Malaya Agreement (Amendment No. 4) Ordinance 1956 on 25th September, 1958, and the Department has thereby lost the services of yet another very competent officer.

Following a brilliant academic career at London, Cambridge and Trinidad, Mr. Johnston arrived in Malaya in 1946 and with Mr. Thompson, the then Senior Plant Pathologist, he set about re-organising the plant protection services of the Department and restoring and enlarging the records of plant diseases. In 1955 Mr. Johnston was appointed Senior Plant Pathologist and has also acted as Senior Entomologist and Assistant Director of Agriculture (Research) in recent years.

Although he has been successful in elucidating causes and cures for many of the recent plant diseases in Malaya, probably his greatest achievement was the work he did on the control of Blister blight of tea at the Cameron Highlands, which at one time constituted a serious threat to the highland tea industry in Malaya. He was a man who was intensely interested in his work and possessed a remarkably equable temperament. It is satisfying to know that the Department will still be able to benefit from his advice when necessary, as he anticipates continuing his career as a Plant Protection Officer with the Food and Agricultural Organisation in the Regional Office in Bangkok.

Mr. Johnston was an active member of the Malayan Nature Society and one of his favourite pastimes was exploring the highways and byways of the country. He took a very great interest in photography, in which he was of professional standard, and left behind in the Pathology Division a very comprehensive photographic record of the plant diseases of this country.

Mrs. Johnston's departure will also be felt, especially by many of the voluntary organisations of Kuala Lumpur. She was a temporary botanist in the Department from 1948 to 1950 and was responsible for many of the statistical analyses in the early part of the post-war padi breeding programme. She was also a Girl Guide Commissioner and an ardent church worker.

We wish them both every success in the future.

STATISTICS

April to June, 1958

Rubber.—The price of rubber, as quoted by the Singapore Chamber of Commerce Rubber Association, declined by about two cents per pound below the previous quarter. International Type I (R.S.S.I.) averaged 76.65, 73.13 and 74.76 cents per pound f.o.b. for the months of April, May and June respectively.

During the quarter a section of the production side of the industry continued to press for a price stabilization policy, but Government representatives have rightly stressed that such a policy could only succeed with the full cooperation of both the manufacturers and the producers. Price support for high cost producers would destroy the chances of natural rubber as a competitor with synthetic in world markets.

Oil Palm.—With increasing production, the price for palm oil declined on average during the quarter by $44 per ton below the figures for January to March. This was in line with the generally lower levels of world commodity prices.

Copra.—The copra price averaged about $32 per pikul during the period, which was an improvement over the first quarter.

The improved price brought out an increase in smallholders' production in May, probably through renewed harvesting of the crop in abandoned areas. The figures show, however, that such an increase is unlikely to be maintained (Table VI).

Table I

AVERAGE MONTHLY PRICES PAID BY LOCAL DEALERS FOR SMALLHOLDERS' RUBBER, APRIL TO JUNE, 1958

(dollars per pikul*)

Grades	Alor Star, Kedah			Seremban, Negri Sembilan			Johore Bahru, Johore		
	April	May	June	April	May	June	April	May	June
Smoked Sheet No. 1	88.24	—	86.38	88.10	—	86.66	88.00	—	86.65
Smoked Sheet No. 2	82.50	—	82.18	82.11	—	83.48	82.16	—	83.50

* 1 pikul = 133⅓ lb.

This table has been compiled from statistics supplied by the Chief Statistician, Federation of Malaya.

Table II

RUBBER PRODUCTION
FEDERATION OF MALAYA

(long tons, dry weight)

Month	Estates		Smallholdings (Estimated)		Total	
	1957	1958	1957	1958	1957	1958
January -	36,070	35,800	27,184	25,400	63,260	61,200
February -	27,002	28,800	21,998	22,900	49,000	51,700
March -	25,908	28,400	20,915	20,300	46,823	48,700
April -	26,501	26,600	22,460	18,200	48,961	44,800
May -	27,129	27,200	18,305	18,100	45,434	45,300
June -	29,628	31,200	21,583	21,800	51,211	53,000
July -	32,405	36,500	24,054	23,700	57,459	60,200
August -	32,957		23,119		56,076	
September -	31,418		21,374		52,792	
October -	33,290		22,462		55,752	
November -	34,369		22,594		56,963	
December -	32,390		21,976		54,366	
Total -	369,073		268,024		637,097	
Total 1956 -	352,233		273,368		625,601	

This table has been compiled from statistics published by the Chief Statistician, Federation of Malaya.

Production on smallholdings (estates of less than 100 acres) is taken as the total of purchases from smallholders reported by licensed dealers.

Table III

AVERAGE PRICES PAID IN LONDON FOR TEA

(s.d. per lb.)

For the Week Ending	Malayan		Ceylon		Indonesian		India				Africa	
							Northern		Southern			
	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.
3.4.58	4	1.39	5	1.06	3	6.71	4	10.84	4	0.36	3	2.35
18.4.58	3	9.02	5	3.65	3	5.24	5	0.78	4	2.47	3	2.32
25.4.58	4	3.84	5	6.93	3	4.37	5	3.26	4	3.77	3	3.90
2.5.58	4	6.28	5	7.51	3	9.98	5	6.51	4	5.84	3	6.92
9.5.58	4	7.14	5	5.91	3	7.00	5	5.31	4	5.73	3	5.18
16.5.58	5	0.12	5	6.18		Nil	5	3.34	4	7.71	3	7.48
23.5.58	4	0.74	5	7.38		Nil	5	3.96	4	7.19	3	8.56
6.6.58	4	11.25	5	6.67	3	9.72	5	2.61	4	6.25	3	7.31
4.7.58	4	3.05	5	3.40		Nil	5	0.37	4	3.20	3	6.51
11.7.58	4	0.42	5	1.36	3	5.74	4	3.43	4	0.88	3	4.94
25.7.58	4	2.26	4	8.86	2	10.68	5	4.78	3	1.54	3	6.70
1.8.58	4	0.53	4	7.05	3	2.81	5	6.35	3	8.36	3	3.75
15.8.58	4	3.05	4	4.71		Nil	5	9.30	3	8.36	3	3.62
22.8.58	3	7.85	4	4.10		Nil	6	2.03	3	8.26	3	4.68
29.8.58	3	7.57	4	4.26	4	6.00	5	10.81	3	7.34	3	3.70

Table IV

AVERAGE DEALERS' PRICES FOR DRIED LIBERICAN COFFEE BEANS GROWN IN SELANGOR*

(dollars per pikul †)

For the Week Ending	Klang	Kuala Langat
	$	$
19- 7-58	164.00	162.00
26- 7-58	165.00	162.00
2- 8-58	165.00	163.00
9- 8-58	165.00	165.00
18- 8-58	165.00	162.00
23- 8-58	165.00	165.00
30- 8-58	165.00	165.00
6- 9-58	165.00	163.00
13- 9-58	165.00	163.00
19- 9-58	165.00	164.00
27- 9-58	165.00	163.00
4-10-58	165.00	163.00

* These are not the prices paid to smallholders, who sell freshly harvested berries to dealers for processing.

† 1 pikul = 133⅓ lb.

Table V

PRODUCTION OF PALM OIL AND KERNELS AND PRICES OF PALM OIL

(long tons, as declared by estates)

Month	Production of Palm Oil (long tons)		Production of Palm Kernels (long tons)		Average Price per Ton of Palm Oil *
	1957	1958	1957	1958	1958
					£ s. d.
January -	3,527	3,581	921	981	77 14 0
February -	3,572	4,460	926	1,192	78 2 0
March -	4,828	6,090	1,225	1,645	80 7 0
April -	4,585	5,748	1,168	1,552	78 14 0
May -	4,689	5,609	1,096	1,408	78 17 0
June -	5,140	5,782	1,203	1,398	74 15 0
July -	5,823	7,243	1,480	1,874	72 10 0
August -	5,355		1,445		
September -	5,666		1,408		
October -	5,896		1,465		
November -	5,070		1,341		
December -	5,356		1,103		
Total -	58,507		14,781		

* F.O.B.

Table VI

PRODUCTION OF COPRA, COCONUT OIL AND COPRA CAKE
FEDERATION OF MALAYA

(tons)

Month	Copra Production						Coconut Oil Production *		Copra Cake (Poonac) Manufactured	
	Estates		Smallholdings (estimated)		Total		Oil Mills		Oil Mills	
	1957	1958	1957	1958	1957	1958	1957	1958	1957	1958
January	2,473	2,449	8,454	1,857	10,927	4,306	8,272	8,164	5,160	5,136
February	2,339	2,546	5,916	8,100	8,255	10,646	7,919	5,458	4,803	3,397
March	2,725	2,895	5,510	7,028	8,235	9,923	8,677	7,032	5,340	4,469
April	2,848	2,910	6,975	8,421	9,824	11,331	6,618	6,032	4,245	3,905
May	3,098	3,275	8,185	11,123	11,283	14,378	6,614	7,223	4,163	4,690
June	3,513	3,431	7,235	3,447	10,748	6,878	8,541	7,485	5,405	4,886
July	4,105	3,985	10,456	8,572	14,561	12,557	8,879	7,828	5,649	5,183
August	3,488		10,865		14,353		8,775		5,528	
September	3,195		7,948		11,143		8,704		5,470	
October	2,880		9,935		12,815		9,174		5,753	
November	2,591		5,285		7,876		8,347		5,231	
December	2,587		7,671		10,258		5,988		3,941	
Total	35,843		94,435		130,278		96,508		60,688	

Notes:—1. The above table has been compiled from statistics published by the Chief Statistician, Federation of Malaya.

2. Estate copra production and coconut oil production are as declared by estates and oil mills, respectively.

3. Statistics of smallholding coconut oil production are not available.

4. Smallholding copra production for commercial purposes is estimated from the formula: imports + estate stocks (opening) + estate production + smallholding production = exports + local oil mill consumption + estate stocks (closing).

* Includes both refined and crude oil.

Table VII

SINGAPORE PRICES OF VARIOUS AGRICULTURAL PRODUCTS

(dollars per pikul †)

Date	Copra, Sundried	Coconut Oil *	Pepper, F.A.Q. Muntok White	Pepper, Gen. Muntok White	Gambier, Cube	Sago Flour, Lingga	Tapioca Flour No. 1	Oilcake, Round
5-5-58	32.75	50.50	131.00	141.00	50.00	9.12	19.00	14.00
12-5-58	34.00	52.00	127.50	138.50	53.00	9.12	19.00	14.00
19-5-58	33.00	51.00	128.00	138.00	53.00	9.12	19.00	13.75
26-5-58	33.00	51.00	122.00	132.00	53.00	9.00	19.00	14.50
2-6-58	33.75	51.00	120.50	130.50	50.00	9.00	18.75	15.00
9-6-58	33.75	51.50	121.50	131.00	50.00	9.00	18.75	13.50
16-6-58	32.50	51.50	121.00	131.00	50.00	9.12	18.75	13.50
23-6-58	32.50	50.50	127.00	137.00	50.00	9.12	17.00	13.50
30-6-58	32.50	51.00	127.00	137.00	50.00	9.50	17.00	13.00
7-7-58	31.50	49.75	126.00	136.00	50.00	9.37	17.00	13.00
14-7-58	31.00	50.50	130.00	142.00	50.00	9.50	17.00	13.00
21-7-58	32.00	52.50	137.00	147.00	48.00	9.50	18.00	12.00
28-7-58	32.50	51.75	135.00	145.00	50.00	9.50	18.00	12.50

† 1 pikul = 133⅓ lb.
* F.O.B. in second-hand drums.
‡ Nominal.
The above prices are taken from the weekly reports of the Singapore Chamber of Commerce.

Table VIII

MALAYAN AGRICULTURAL EXPORTS,
JANUARY TO DECEMBER, 1957

Product	Net Exports in Tons		
	Year 1955	Year 1956	Year 1957
Arecanuts	13,679	11,228	9,625
Coconuts, fresh †	72,140	34,779	37,466
Coconut oil	91,176	103,132	100,031
Copra	75,076 *	82,549 *	71,718 *
Copra cake	56,404 *	66,174 *	73,208 *
Gambier, all kinds	66	96	3
Palm Oil	52,832	55,252	56,728
Pineapples, canned	27,756	30,377	37,671
Sago, flour	23,053	21,483	19,581
Sago, pearl	5,483	4,276	4,021
Sago, raw	18,709 *	18,522 *	14,006 *
Tapioca, flake	475	260	403
Tapioca, flour	3,979 *	3,753 *	1,573 *
Tapioca, pearl	5,470	5,630	5,222

† hundreds. * net imports.

METEOROLOGICAL SUMMARY, MALAYA, MAY, 1958

Locality	Air Temperature Degrees Fahrenheit							Earth Temperature		Rainfall								Bright Sunshine		
	Means of		Means of A and B	Absolute Extremes				At 4	At 1			Most in a day	Number of Days							
	A.	B.		Highest Max.	Lowest Max.	Lowest Min.	Highest Min.	foot	feet	Total			Precipitation 0.10 or more	Precipitation 0.4 or more	Thunderstorm	Fog morning only	Gale force 34 or more	Total	Daily Mean	Per cent.
	Max.	Min.		°F	°F	°F	°F	°F	°F			Amt.								
Ipoh, Perak	92.2	75.5	83.8	95.9	72.6	88.3	78.4			10.33	262.4	2.95	21	17	8			198.10	6.39	
Kuala Lumpur, Selangor	91.0	74.7	83.8	93.5	73.0	83.8	76.8			11.20	284.5	1.90	18	16	10	2		181.60	5.86	
Sitiawan, Perak	89.9	75.1	82.5	93.4	72.2	85.5	77.4	85.3	86.3	6.10	154.9	1.38	16	13	3	1		191.60	6.18	
Kuantan, Pahang	91.0	73.9	82.5	96.7	70.6	82.5	77.0	85.5		2.49	63.2	0.63	14	10	4	2		172.30	5.56	
Bayan Lepas, Penang	88.2	76.5	82.3	91.2	73.4	83.2	79.6			19.93	506.2	9.08	21	21	6			185.20	5.97	
Malacca	88.3	75.0	81.7	92.0	72.5	82.1	77.2			8.01	203.5	1.33	23	18	8	1		168.55	5.43	
Mersing, Johore	89.2	73.8	81.5	92.6	71.4	80.0	75.8			5.29	134.4	1.87	16	13	1			182.10	5.87	
Alor Star, Kedah	90.8	75.6	83.2	95.4	74.0	84.9	78.5			9.87	250.7	2.50	20	7	4			209.25	6.75	
Kota Bharu, Kelantan	91.7	76.5	84.1	95.0	73.4	86.6	78.1	91.2	90.5	2.35	59.7	1.23	10		3			215.55	6.95	
K. Trengganu Trengganu	90.3	75.2	82.7	92.7	71.5	86.4	77.1			3.82	97.0	2.28	15	9		10		227.55	7.34	
Singapore	88.8	75.6	82.2	92.2	74.2	81.3	77.2			5.98	151.9	1.48	19	13	7			144.85	6.7	
HILL STATIONS																				
Cameron Highlands, Tanah Rata, Pahang. (3750 ft.)	73.8	59.2	66.5	76.5	55.0	68.0	63.0			14.47	367.5	2.02	29	22				84.05	2.71	

Compiled from returns supplied by the Malayan Meteorological Service

METEOROLOGICAL SUMMARY, MALAYA, JUNE, 1958

Locality	Air Temperature Degrees Fahrenheit							Earth Temperature		Rainfall								Bright Sunshine		
	Means of			Absolute Extremes				At 1 foot	At 4 feet	Total		Most in a day	Number of Days					Total	Daily Mean	Per cent.
	A. Max.	B. Min.	Means of A and B	Highest Max.	Lowest Min.	Lowest Max.	Highest Min.	° F	° F			Amt.	Precipitation .01 in. or more	Precipitation .04 in. or more	Thunderstorm	Fog morning obs.	Gale force 8 or more			
										in.	mm.	in.						hr.	hr.	
Ipoh, Perak	93.5	94.3	83.9	97.4	71.1	86.6	76.8			5.67	144.0	2.18	11	7	5			223.95	7.47	
Kuala Lumpur, Selangor	92.1	74.2	83.1	95.0	72.2	88.0	76.6			2.94	74.7	0.86	15	10	4		1	214.70	7.16	
Sitiawan, Perak	91.2	74.1	82.7	83.7	70.1	87.0	77.1	86.4	86.7	0.74	18.8	0.60	6	3	1			230.80	7.69	
Kuantan, Pahang	92.2	73.0	82.6	98.1	69.2	86.3	75.4	86.3		12.59	319.8	4.10	12	9	7	3		229.30	7.64	
Bayan Lepas, Penang	86.6	75.4	82.0	91.0	70.0	85.6	78.9			11.10	281.9	2.66	14	13	4			202.35	6.75	
Malacca	88.5	74.5	81.5	90.2	72.2	85.0	76.1			9.34	237.2	4.75	11	10	2			203.50	6.78	
Mersing, Johore	88.8	73.1	80.9	93.2	70.8	79.9	76.6			4.87	123.7	1.16	16	15				194.40	6.48	
Alor Star, Kedah	89.6	75.4	82.5	92.8	71.8	82.8	78.4			7.36	186.9	3.64	20	19				215.40	7.18	
Kota Bharu, Kelantan	90.7	75.5	83.1	94.0	72.0	84.5	79.0	88.1	88.5	5.57	141.5	1.95	16	11	7			222.35	7.41	
K. Trengganu, Trengganu	90.3	74.5	82.4	92.3	72.4	85.0	77.7			1.48	37.6	0.70	12	6				241.15	8.04	
Singapore	88.8	75.9	82.3	92.2	72.5	82.8	79.1			7.21	183.1	2.05	14	11				165.05	5.50	
HILL STATION																				
Cameron Highlands, Tanah Rata, Pahang. (4750 ft.)	74.4	56.7	65.5	77.0	52.3	71.1	61.2			3.49	88.6	0.65	12	11				151.05	5.03	

Compiled from returns supplied by the Malayan Meteorological Service.

METEOROLOGICAL SUMMARY, MALAYA, JULY, 1958

Locality	Air Temperature Degrees Fahrenheit							Earth Temperature		Rainfall								Bright Sunshine		
	Means of			Absolute Extremes				At 1 foot	At 4 feet				Number of Days							
	A.	B.	Means of A and B	Highest Max.	Lowest Min.	Lowest Max.	Highest Min.			Total	Most in a day		Precipitation .01 in. or more	Precipitation .04 in. or more	Thunderstorm	Fog morning obs.	Gale force 8 or more	Total	Daily Mean	Per cent.
	Max.	Min.									Amt.									
								° F	° F	in.	mm.	in.						hr.	hr.	
Ipoh, Perak	94.0	72.8	83.4	96.6	66.2	88.0	76.7			33.1	84.1	0.99	8	7	7		2	251.30	8.11	
Kuala Lumpur, Selangor	93.1	72.1	82.6	96.7	65.4	88.8	75.0			1.47	37.3	0.77	9	8	3			253.05	8.16	
Sitiawan, Perak	92.7	72.2	82.5	94.7	67.0	89.2	75.0	86.6	86.9	0.03	0.8	0.03	1			1		262.90	8.48	
Kuantan, Pahang	91.9	72.4	82.1	97.0	65.5	82.6	77.1	85.7		0.41	13.0	0.25	4	4	3	3		237.30	7.65	
Bayan Lepas, Penang	88.3	74.3	81.3	91.2	67.7	82.0	76.9			6.96	176.8	2.61	11	9	3	5		252.15	8.13	
Malacca	89.0	71.9	80.5	91.2	66.4	85.0	74.6			5.43	137.9	1.67	9	8	5			256.20	8.26	
Mersing, Johore	89.3	72.0	80.7	92.0	68.8	84.4	75.7			3.67	93.2	0.98	8	8				248.05	8.00	
Alor Star, Kedah	90.4	74.3	82.3	93.7	71.5	81.8	76.8			2.87	72.8	1.08	9	9	1			240.45	7.76	
Kota Bharu, Kelantan	89.6	74.5	82.1	91.8	69.7	85.8	79.1	86.9	87.2	2.95	74.9	1.60	10	8	7		4	241.95	7.80	
K. Trengganu, Trengganu	89.5	73.9	81.7	92.3	70.4	85.0	76.8			3.93	99.8	1.52	7	6	1	1		214.90	6.93	
Singapore	90.0	75.0	82.5	93.0	90.4	83.0	80.5			0.98	24.9	0.40	7	5	1	1		229.60	7.41	
HILL STATION																				
Cameron Highlands, Tanah Rata, Pahang. (4750 ft.)	75.0	52.5	63.7	76.9	43.5	71.8	57.8			3.20	81.3	1.40	8	8				183.05	5.90	

Compiled from returns supplied by the Malayan Meteorological Service.

MINISTRY OF AGRICULTURE

THE MALAYAN AGRICULTURAL JOURNAL
(Vol. 41, No. 4)

Special Rice Issue

The special Rice Issue of the Malayan Agricultural Journal will be published in February, 1959, and will contain articles covering all aspects of padi production and research on this crop in Malaya.

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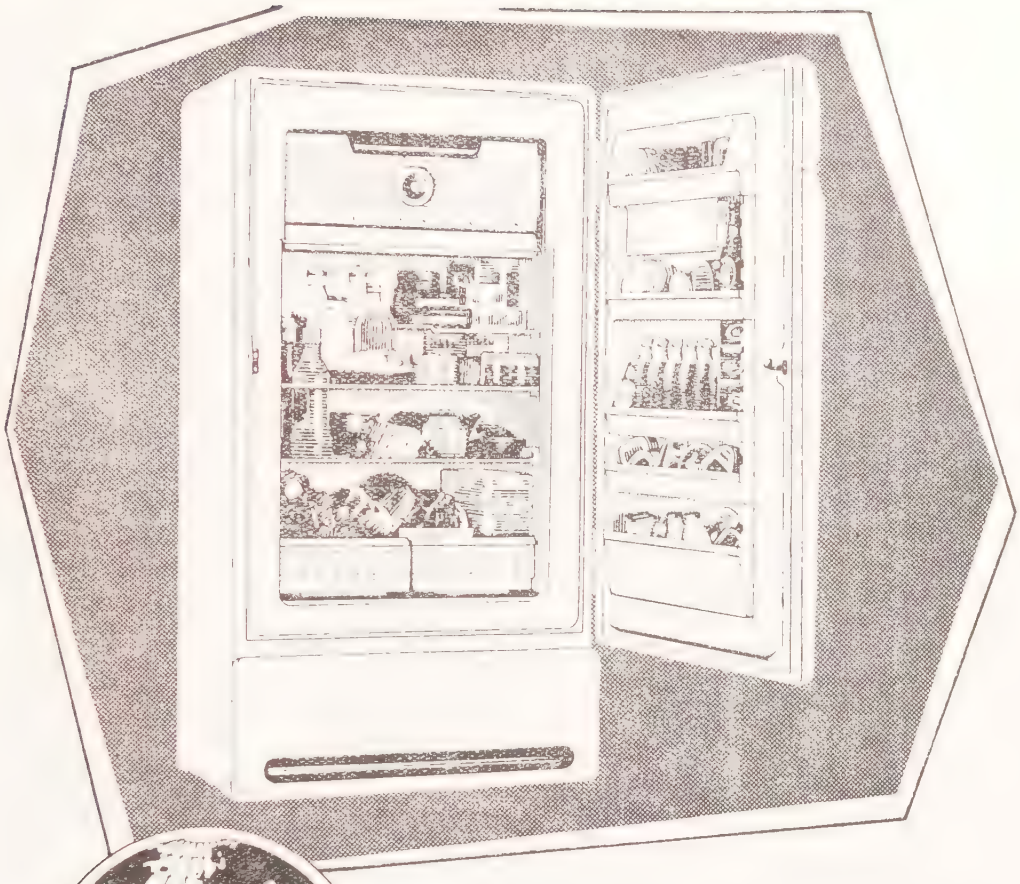

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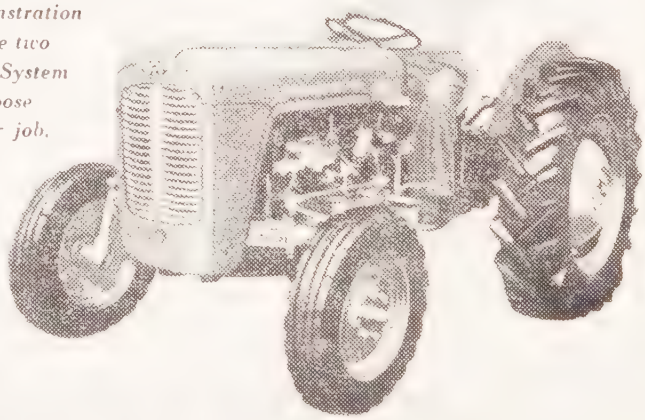

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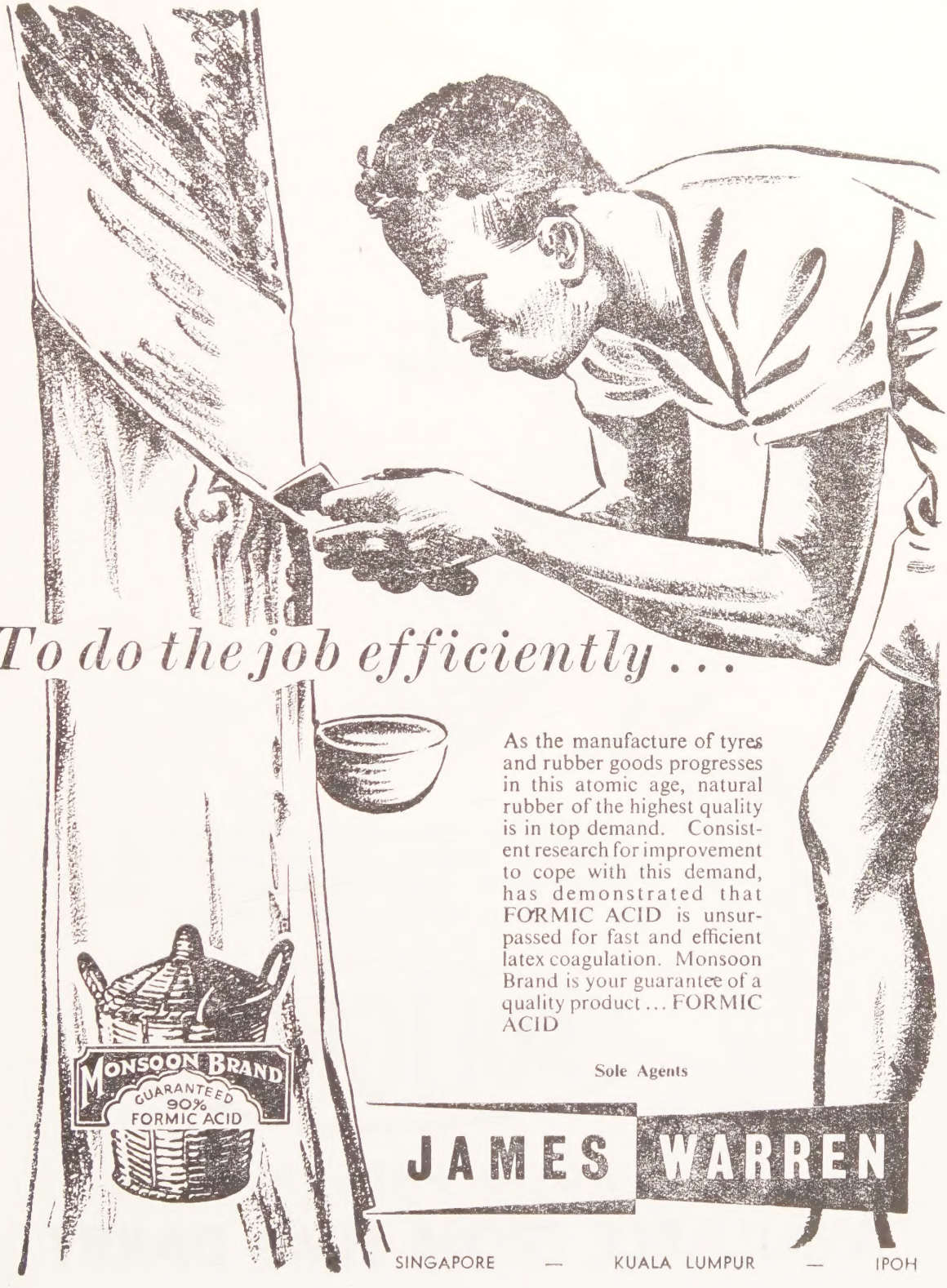
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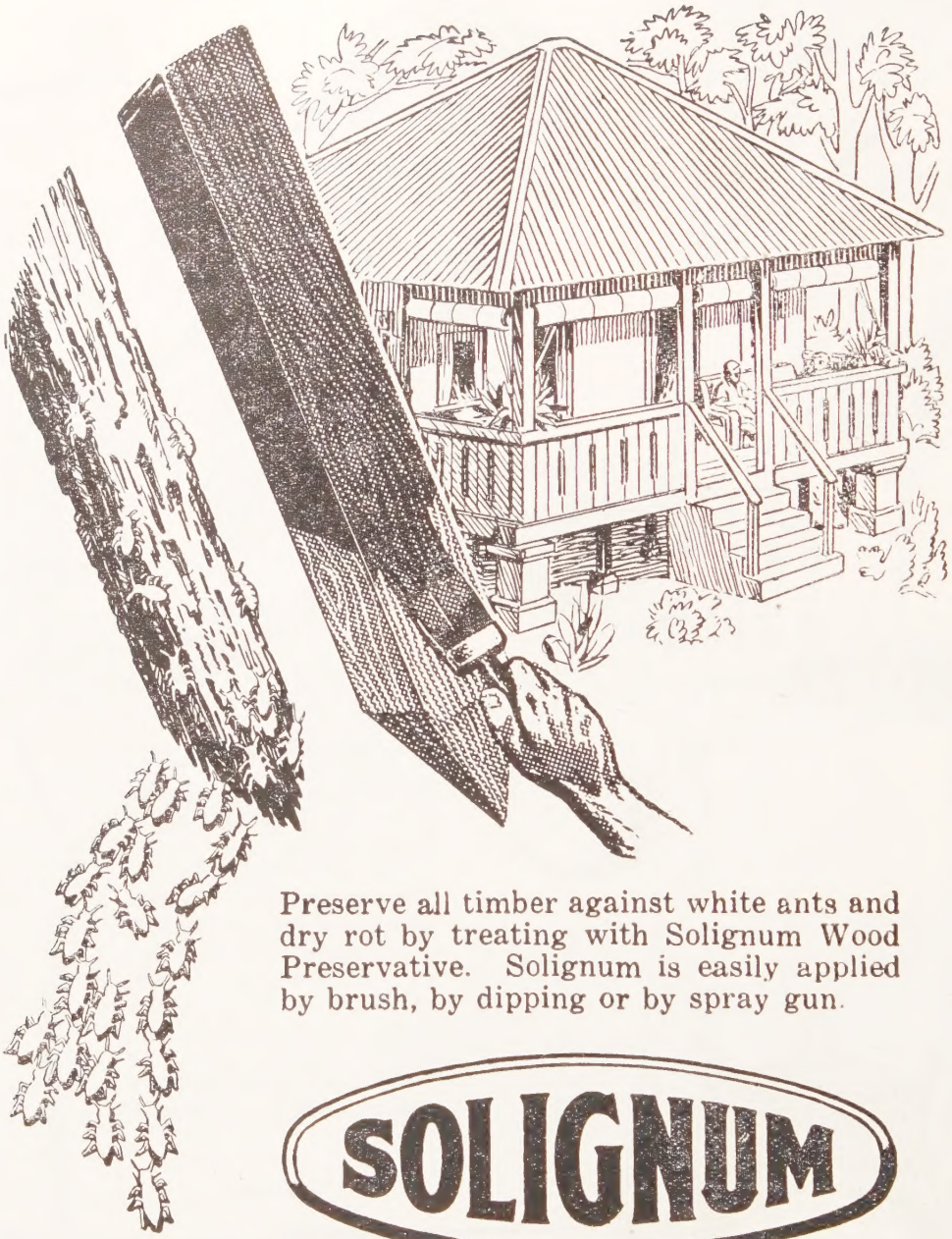

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Correspondence concerning the experiments at any of these Stations should, if it originates in Malaya, be addressed to the State Agricultural Officer, concerned; correspondence originating in any other country should be addressed to the Director of Agriculture, Federation of Malaya, Kuala Lumpur.

Wet Padi.

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Federal Experiment Stations, Serdang, Selangor, and Jerangau, Trengganu.

Coconut.

Federal Experiment Station, Telok Bharu, Perak, and Coconut (Rehabilitation) Station, Sungei Sudah, Muar, Johore.

Cacao.

FEDERAL EXPERIMENT STATIONS. Serdang, Selangor, and Jerangau, Trengganu.

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Pineapple.

Jalan Kebun, Selangor, and Alor Bukit, Johore.

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Fruit Propagation.

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